

**CODE OF PRACTICE**  
**FOR**  
**OVERALL THERMAL TRANSFER VALUE**  
**IN BUILDINGS**

**1995**

**BUILDING AUTHORITY**  
**HONG KONG**

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## **Foreword**

A consultancy study in 1991 found that if the envelope of a building was constructed to a suitable overall thermal transfer value (OTTV), electricity demand from air-conditioning and thus the emission of greenhouse gases from power generation could be reduced. The Government's aim is to establish a comprehensive building energy code to control the total energy consumption of a building, of which OTTV controls would form a part. As a first step, legislative control over OTTV has been introduced in the Building (Energy Efficiency) Regulation (Cap. 123 sub. leg.).

This Code of Practice provides technical guidance for authorized persons, registered structural engineers and other persons responsible for the design and construction of buildings. Compliance with the provisions in this Code may be deemed to satisfy the requirement of a suitable OTTV for a building under the Building (Energy Efficiency) Regulation.

This Code will be regularly reviewed. The Building Authority welcomes suggestions for improving this Code or for enhancing the energy efficiency of buildings in general.

Other options for achieving equivalent and better performance standards are available and will of course be considered in isolation or in combination for the purpose of establishing acceptability.

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## 1. **General Principles of Control of Overall Thermal Transfer Value**

1.1 For the design and planning of energy - efficient buildings, Government is developing a comprehensive energy code to cover inter alia lighting and air-conditioning. Overall thermal transfer value (OTTV) is one aspect of energy conservation.

### **General approach**

1.2 An OTTV is a measure of the energy consumption of a building envelope. Its formulation allows authorized persons, registered structural engineers and other persons responsible for the design and construction of buildings freedom to innovate and vary important envelope components such as type of glazing, window size, external shading to windows, wall colour and wall type to meet the maximum OTTV criteria. Any measure to improve energy efficiency or to save energy should be considered in planning a building.

1.3 Siting a building to avoid extensive glazed facades with a southerly aspect or introducing shades to window areas can reduce solar heat gain. Appropriate choice of windows with a low thermal transmittance characteristic will also minimize solar heat transmission.

1.4 Artificial lighting consumes electricity and creates heat. This increases the cooling load of a building and in turn increases energy consumption. Consequently, when determining the size and location of windows as well as choice of glass in the envelope of a building, efforts should be made to provide as much natural lighting into the building as possible. For example, with glazing, the visible lighting transmittance should be acknowledged in addition to its thermal transmittance properties; daylight can supplement artificial lighting and consequently reduce the cooling load.

1.5 Other measures include more extensive use of energy-efficient building services equipment and appliances, e.g. energy-saving lamps, low-loss luminaries and high-efficiency air-conditioning and more sophisticated building services control systems.

## **Scope**

1.6 The provisions in this Code apply to all hotels and commercial buildings as defined in the Building (Energy Efficiency) Regulation. They aim at reducing heat transfer through the building envelope and thus the electricity required for air-conditioning.

1.7 The concept of OTTV is based on the assumption that the envelope of a building is completely enclosed.

1.8 In the OTTV formulation, the following factors are not addressed or allowed for :

- (a) Internal shading devices, such as draperies and blinds.
- (b) Solar reflection or shading from adjacent buildings.

## **2. Definitions**

In this Code, unless otherwise stated, words and expressions have the meaning attributed to them by the Building (Energy Efficiency) Regulation. It should also be noted that :

"building tower" means that part of a building above the podium of the building;

"fenestration" means any glazed aperture in the building envelope;

"lightwell" means a vertical shaft of open air enclosed on all sides by parts of a building;

"opaque" wall or roof means that solid part of the wall or roof which is not part of the fenestration;

"podium" means that part of a building which,

- (a) if having a site coverage exceeding the permitted percentage site coverage, is -
  - (i) within 15 m above ground level as permitted under Building (Planning) Regulation 20(3); or
  - (ii) within such height as is permitted by the Building Authority by way of a modification of that regulation granted under section 42 of the Buildings Ordinance; and
- (b) if having a site coverage within the permitted percentage site coverage, is within 15 m above ground level.

"refuge floor" has the meaning assigned to it in the Code of Practice for Means of Escape and means a protected floor that serves as a refuge for the occupants of the building to assemble in case of fire.

### 3. **Suitable OTTV**

3.1 The external walls and roofs of a building to which the Building (Energy Efficiency) Regulation applies should be designed and constructed to have the following OTTV :

- (a) in the case of a building tower; the OTTV should not exceed 35 W/m<sup>2</sup>; and
- (b) in the case of a podium; the OTTV should not exceed 80 W/m<sup>2</sup>.

3.2 The maximum OTTV specified in paragraph 3.1 should apply to the overall building envelope, i.e. all the external walls and roofs, as the case may be, in average and do not apply to the individual wall or roof.

3.3 The OTTV of the external walls and roofs of a building tower or podium should be assessed in accordance with methods set out in this Code. A sample of OTTV calculations for a typical commercial building is set out in Appendix for illustration.

#### 4. **Principles of OTTV Calculations**

##### **External walls and roofs not included in OTTV calculations**

4.1 All external walls and roofs of a building should be included in OTTV calculations except -

- (a) an external wall of a refuge floor;
- (b) an external wall or roof of a carparking floor;
- (c) an external wall of a lightwell having an area on plan not exceeding 21 m<sup>2</sup>; and
- (d) any wall on any roof.

##### **Party wall**

4.2 An external wall of a building which is a party wall should be included in OTTV calculations whether an adjoining building exists or not. Shading to the party wall from adjoining buildings should not be considered in calculating the OTTV.

## 5. OTTV of External Walls

The OTTV of the external walls of a building tower or a podium, OTTV<sub>w</sub>, should be calculated using the following formula -

$$\text{OTTV}_w = \frac{(A_w \times U \times \alpha \times \text{TDEQ}_w) + (A_{f_w} \times \text{SC} \times \text{ESM} \times \text{SF})}{A_{o_w}}$$

where

- A<sub>w</sub> = Area of opaque wall, m<sup>2</sup>
- U = Thermal transmittance of opaque wall, W/m<sup>2</sup>°C (See para 7.1)
- α = Absorptivity of the opaque wall (Table 4)
- TDEQ<sub>w</sub> = Equivalent temperature difference for wall, °C (Table 5)
- A<sub>f<sub>w</sub></sub> = Area of fenestration in wall, m<sup>2</sup>
- SC = Shading coefficient of fenestration in wall (See para 7.5)
- ESM = External shading multiplier (Table 6 and 7)
- SF = Solar factor for the vertical surface, W/m<sup>2</sup> (Table 8)
- A<sub>o<sub>w</sub></sub> = Gross area of external walls, i.e. A<sub>w</sub> + A<sub>f<sub>w</sub></sub>, m<sup>2</sup>

## 6. OTTV of Roofs

The OTTV of the roofs of a building tower or a podium, OTTV<sub>r</sub>, should be calculated using the following formula :-

$$\text{OTTV}_r = \frac{(A_r \times U \times \alpha \times \text{TDEQ}_r) + (A_{f_r} \times \text{SC} \times \text{SF})}{A_{o_r}}$$

Where

- A<sub>r</sub> = Area of opaque roof, m<sup>2</sup>
- U = Thermal transmittance of opaque roof, W/m<sup>2</sup>°C (See para 7.1)
- α = Absorptivity of the opaque roof (Table 4)
- TDEQ<sub>r</sub> = Equivalent temperature difference for roof, °C (Table 9)
- A<sub>f<sub>r</sub></sub> = Area of fenestration in roof, m<sup>2</sup>
- SC = Shading coefficient of fenestration in roof (See para 7.5)
- SF = Solar factor for horizontal surface, W/m<sup>2</sup> (Table 8)
- A<sub>o<sub>r</sub></sub> = Gross area of roof, i.e. A<sub>r</sub> + A<sub>f<sub>r</sub></sub>, m<sup>2</sup>



## 7. Calculation of Component Coefficients and Parameters of OTTV

### Thermal transmittance of opaque construction (U)

7.1 Opaque walls and roofs usually involve a composite of materials. The thermal transmittance of an opaque wall or roof should be derived by the following formula :

$$U = \frac{1}{R_i + \frac{x_1}{k_1} + \frac{x_2}{k_2} + \dots + \frac{x_n}{k_n} + R_a + R_o}$$

x = Thickness of building material of the wall or roof or part thereof, m

k = Thermal conductivity of the building material, W/m°C  
(Table 1)

R<sub>i</sub> = Surface film resistance of internal surface of the wall or roof, m²°C/W  
(Table 2)

R<sub>o</sub> = Surface film resistance of external surface of the wall or roof, m²°C/W  
(Table 2)

R<sub>a</sub> = Air space resistance, m²°C/W (Table 3)

### Component coefficients and parameters of thermal transmittance

7.2 The component coefficients and parameters used in calculating the thermal transmittance of opaque construction should be assessed as follows :

(a) Thermal conductivity of building materials (k)

The thermal conductivity of the building materials of walls and roofs should be obtained from Table 1.

**Table 1 Thermal Conductivity of Building Materials**

Material	Density kg/m <sup>3</sup>	Thermal Conductivity (k) W/m°C
Asphalt, mastic with 20% grit	2350	1.15
Boards		
a) cork	145	0.042
b) hardboard high density	1010	0.144
c) mineral fibre	265	0.053
d) plasterboard	950	0.16
Brick (common)	1900	0.95
Concrete		
a) normal weight aggregate	2400	2.16
b) lightweight aggregate	1300	0.44
c) flat roof tiles or slabs	2100	1.10
Glass	2500	1.05
Mosaic tile cladding	2500	1.50
Insulating materials		
a) glass fibre mat or quilt	32	0.035
b) mineral wool felt	50	0.039
c) polystyrene expanded	25	0.034
d) polyurethane foam	30	0.026
Metals		
a) aluminium alloy typical	2800	160
b) copper commercial	8900	200
c) steel, carbon	7800	50
Plaster/render		
a) gypsum	1120	0.38
b) gypsum, sand aggregate	1570	0.53
c) cement/sand	1860	0.72
Screeding		
a) cement sand	1860	0.72
b) terrazzo	2435	1.59
Stone		
a) granite	2650	2.9
b) marble	2500	2.0

Note :

If other materials are used the thermal conductivity values should be subject to the acceptance of the Building Authority and the source of the information from which the thermal conductivity values are obtained should be submitted for his consideration for this purpose.

(b) Surface film resistance for walls and roofs ( $R_i$ ,  $R_o$ )

The surface film resistance for walls and roofs should be obtained from Table 2.

**Table 2 Surface Film Resistance for Walls and Roofs**

Type of surface	Surface film resistance $m^2\text{°C/W}$
<p>Surface film resistance for walls</p> <p>1. Internal surface (<math>R_i</math>)</p> <p>(a) Absorptivity (0.5 and above) 0.120</p> <p>(b) Absorptivity (below 0.5) 0.299</p> <p>2. External surface (<math>R_o</math>) 0.044</p>	
<p>Surface film resistance for roofs</p> <p>1. Internal surface (<math>R_i</math>)</p> <p>(a) Absorptivity (0.5 and above)</p> <p>(i) Flat roof 0.162</p> <p>(ii) Sloped roof <math>22\frac{1}{2}^\circ</math> 0.148</p> <p>(iii) Sloped roof <math>45^\circ</math> 0.133</p> <p>(b) Absorptivity (below 0.5)</p> <p>(i) Flat roof 0.801</p> <p>(ii) Sloped roof <math>22\frac{1}{2}^\circ</math> 0.595</p> <p>(iii) Sloped roof <math>45^\circ</math> 0.391</p> <p>2. External surface (<math>R_o</math>) 0.055</p>	

(c) Air space resistance for walls and roofs ( $R_a$ )

The air space resistance for walls and roofs should be obtained from Table 3.

**Table 3 Air Space Resistance for Walls and Roofs**

Type of air space	Air space resistance ( $R_a$ ) $m^2\text{°C/W}$					
	5 mm	10 mm	20 mm	50 mm	75 mm	100 mm
Air space resistance for walls						
Vertical air space (heat flows horizontally)						
(a) Absorptivity (0.5 and above)	0.110	0.123	0.148	0.153	0.156	0.160
(b) Absorptivity (below 0.5)	0.250	0.359	0.578	0.589	0.597	0.606
Air space resistance for roofs						
Horizontal or sloping air space (heat flows downward)						
(a) Absorptivity (0.5 and above)						
(i) horizontal air space	0.110	0.123	0.148	0.158	0.166	0.174
(ii) sloped air space $22\frac{1}{2}^\circ$	0.110	0.123	0.148	0.154	0.160	0.165
(iii) sloped air space $45^\circ$	0.110	0.123	0.148	0.152	0.155	0.158
(b) Absorptivity (below 0.5)						
(i) horizontal air space	0.250	0.357	0.572	0.891	1.157	1.423
(ii) sloped air space $22\frac{1}{2}^\circ$	0.250	0.357	0.571	0.768	0.931	1.095
(iii) sloped air space $45^\circ$	0.250	0.357	0.570	0.644	0.706	0.768

**Absorptivity ( $\alpha$ )**

7.3 Energy simulation studies for Hong Kong have shown that the external surface and colour of walls and roofs, and therefore their absorptivity, have a significant effect on chiller energy used. This should be included in the heat gain calculation as a multiplication constant to the equivalent temperature difference. The absorptivity for wall and roof surfaces should be obtained from Table 4.

**Table 4 Absorptivity for wall and roof surfaces**

Material	Absorptivity $\alpha$	Paint	Absorptivity $\alpha$
Black glass	1.0	Optical flat black paint	0.98
Black concrete	0.91	Flat black paint	0.95
Stafford blue brick	0.89	Black lacquer	0.92
Red brick	0.88	Dark grey paint	0.91
Bituminous felt	0.88	Dark blue lacquer	0.91
Blue grey slate	0.87	Black oil paint	0.90
Roofing, green	0.86	Dark olive drab paint	0.89
Brown concrete	0.85	Azure blue or dark green lacquer	0.88
Asphalt pavement, weathered	0.82	Dark brown paint	0.88
Wood, smooth	0.78	Dark blue-grey paint	0.88
Uncoloured concrete	0.65	Medium brown paint	0.84
White marble	0.58	Medium light brown paint	0.80
White mosaic tiles	0.58	Brown or green lacquer	0.79
Light buff brick	0.55	Medium rust paint	0.78
Built-up roof, white	0.50	Light grey oil paint	0.75
Bituminous felt, aluminized	0.40	Red oil paint	0.74
Gravel	0.29	Medium dull green paint	0.59
White on galvanized iron	0.26	Medium orange paint	0.58
White glazed brick	0.25	Medium yellow paint	0.57
Polished aluminium reflector sheet	0.12	Medium blue paint	0.51
Aluminized mylar film	0.10	Medium kelly green paint	0.51
Tinned surface	0.05	Light green paint	0.47
		Aluminium paint	0.40
		White semi-gloss paint	0.30
		White gloss paint	0.25
		Silver paint	0.25
		White lacquer	0.21
		Laboratory vapour deposited coatings	0.02

Note :

Absorptivity for other materials or surfaces should be subject to the acceptance of the Building Authority and the source of the information from which the absorptivity values are obtained should be submitted for his consideration.

### Equivalent temperature difference for walls (TDEQ<sub>w</sub>)

7.4 Energy simulation studies for Hong Kong have indicated that thermal mass affects the total heat flow through walls sufficiently to warrant its inclusion in the formulation of an OTTV. The equivalent temperature difference for walls should take into account the wall mass, density and orientation. Heavyweight construction gives a better performance than lightweight construction because it resists the passage of heat. The equivalent temperature difference for walls should be obtained from Table 5.

**Table 5 Equivalent Temperature Difference for Walls**

Orientation	Density of wall construction				
	less than 22 kg/m <sup>2</sup>	23-199 kg/m <sup>2</sup>	200-379 kg/m <sup>2</sup>	380-569 kg/m <sup>2</sup>	570 kg/m <sup>2</sup> or greater
N	3.70	3.38	2.72	2.05	1.70
NNE	4.65	4.21	3.30	2.36	1.88
NE	5.60	5.03	3.86	2.67	2.05
ENE	6.55	5.86	4.44	2.98	2.23
E	7.50	6.68	5.01	3.28	2.40
ESE	7.05	6.26	4.65	3.00	2.15
SE	6.60	5.85	4.30	2.71	1.90
SSE	6.15	5.43	3.95	2.43	1.65
S	5.70	5.01	3.60	2.15	1.40
SSW	6.15	5.42	3.92	2.37	1.58
SW	6.60	5.82	4.23	2.59	1.75
WSW	6.55	5.81	4.29	2.73	1.93
W	6.50	5.79	4.35	2.86	2.10
WNW	5.80	5.19	3.94	2.66	2.00
NW	5.10	4.59	3.54	2.45	1.90
NNW	4.40	3.98	3.13	2.25	1.80

### Shading coefficient of fenestration (SC)

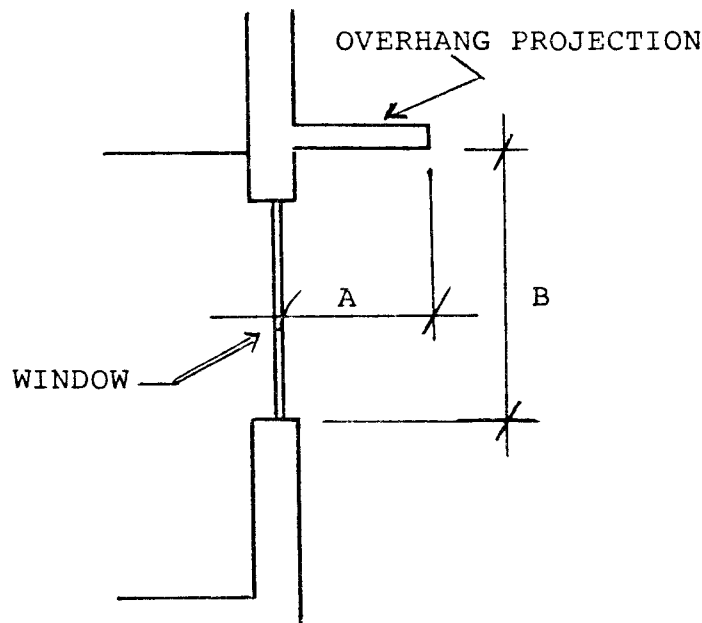
7.5 The shading coefficient of fenestration is the ratio of the solar heat gain through a particular type of glass under a specific set of conditions to the solar heat gain through double strength sheet clear glass under the same conditions. Allowances for Hong Kong's latitude and solar effects have been taken into account in the solar factor and therefore the shading coefficient of glass published by glass manufacturers in Hong Kong or overseas can be used without modification provided that the calculations have been based on a normal angle of incidence.

### External shading multiplier (ESM)

7.6 Shading of windows is of paramount importance in reducing solar heat gain to the building. This shading can be provided by projections over the window, at the side of the window, or a combination of both. For the purpose of simplicity in OTTV calculations this shading effect is taken into account as an external shading multiplier which should be assessed as follows :

#### (a) Overhang projections to windows

The external shading multiplier for overhang projections to windows should be obtained from Table 6 according to the overhang projection factor (OPF) and the orientation of the window. The OPF should be calculated as follows :



$$OPF = \frac{A}{B}$$

**Table 6 External Shading Multiplier for Overhang Projections to Windows**

OPF	ESM			
	N	NE/NW	S/E/W	SE/SW
0.00	1.000	1.000	1.000	1.000
0.05	0.975	0.969	0.962	0.962
0.10	0.951	0.939	0.926	0.926
0.15	0.928	0.909	0.890	0.890
0.20	0.905	0.880	0.856	0.856
0.25	0.883	0.853	0.823	0.823
0.30	0.861	0.826	0.790	0.790
0.35	0.840	0.800	0.759	0.759
0.40	0.820	0.774	0.729	0.729
0.45	0.800	0.750	0.700	0.700
0.50	0.781	0.726	0.672	0.672
0.55	0.762	0.704	0.645	0.645
0.60	0.744	0.682	0.620	0.620
0.65	0.726	0.661	0.595	0.595
0.70	0.710	0.641	0.572	0.572
0.75	0.693	0.621	0.549	0.549
0.80	0.678	0.603	0.528	0.528
0.85	0.663	0.585	0.507	0.507
0.90	0.648	0.568	0.488	0.488
0.95	0.634	0.552	0.470	0.470
1.00	0.621	0.537	0.453	0.453

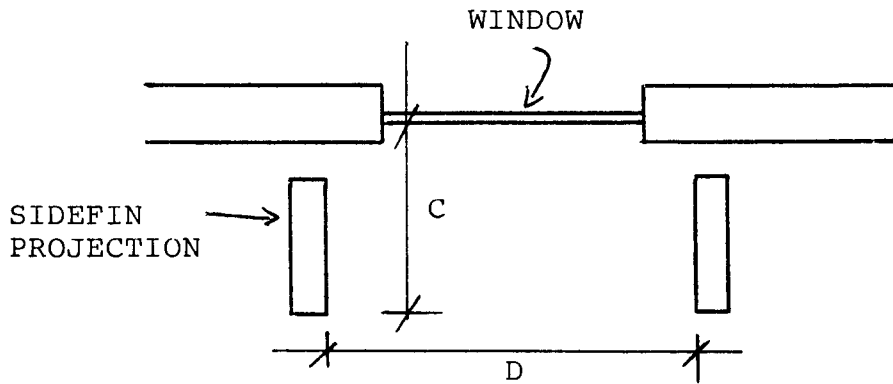
Notes :

- (i) Should the OPF value fall in between increments, adopt the multiplier related to the next larger OPF value.
- (ii) OPF values above 1.0 are considered to produce too great an error in estimation.
- (iii) ESM for South, East and West orientations are combined since the figures are very similar.



(b) Sidefin projections to windows

The external shading multiplier for sidefin projections to windows should be obtained from Table 7 according to the sidefin projection factor (SPF) and the orientation of the window. The SPF should be calculated as follows :



$$SPF = \frac{C}{D}$$

**Table 7 External Shading Multiplier for Sidefin Projections to Windows**

SPF	ESM							
	N	NE	E	SE	S	SW	W	NW
0.00	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
0.05	0.955	0.964	0.974	0.968	0.962	0.968	0.968	0.964
0.10	0.911	0.929	0.948	0.937	0.925	0.936	0.947	0.929
0.15	0.869	0.896	0.923	0.906	0.890	0.906	0.922	0.895
0.20	0.828	0.863	0.898	0.877	0.855	0.876	0.897	0.863
0.25	0.789	0.832	0.875	0.848	0.822	0.848	0.873	0.831
0.30	0.751	0.801	0.852	0.821	0.790	0.820	0.850	0.800
0.35	0.714	0.772	0.829	0.794	0.759	0.793	0.828	0.771

(Cont'd)

**Table 7 External Shading Multiplier for Sidefin  
Projections to Windows (Cont'd)**

SPF	ESM							
	N	NE	E	SE	S	SW	W	NW
0.40	0.679	0.743	0.807	0.768	0.729	0.767	0.806	0.742
0.45	0.645	0.716	0.786	0.743	0.700	0.743	0.785	0.715
0.50	0.613	0.690	0.766	0.719	0.673	0.719	0.765	0.689
0.55	0.582	0.664	0.746	0.696	0.646	0.696	0.746	0.664
0.60	0.553	0.640	0.727	0.674	0.621	0.674	0.727	0.640
0.65	0.525	0.617	0.709	0.653	0.596	0.653	0.709	0.617
0.70	0.499	0.595	0.691	0.632	0.573	0.633	0.692	0.595
0.75	0.473	0.574	0.674	0.613	0.551	0.613	0.675	0.574
0.80	0.450	0.554	0.658	0.594	0.531	0.595	0.660	0.555
0.85	0.428	0.535	0.642	0.577	0.511	0.578	0.645	0.536
0.90	0.407	0.517	0.627	0.560	0.493	0.561	0.630	0.519
0.95	0.388	0.500	0.613	0.544	0.475	0.546	0.617	0.502
1.00	0.370	0.484	0.599	0.529	0.459	0.531	0.604	0.487
1.05	0.354	0.470	0.586	0.515	0.444	0.518	0.592	0.473
1.10	0.339	0.456	0.574	0.502	0.430	0.505	0.581	0.460
1.15	0.325	0.444	0.562	0.490	0.417	0.494	0.570	0.448
1.20	0.313	0.432	0.551	0.478	0.406	0.483	0.560	0.437
1.25	0.302	0.422	0.541	0.468	0.395	0.473	0.551	0.427
1.30	0.293	0.412	0.531	0.458	0.386	0.464	0.543	0.418
1.35	0.286	0.404	0.522	0.450	0.377	0.456	0.535	0.410
1.40	0.279	0.396	0.514	0.442	0.370	0.449	0.528	0.404
1.45	0.274	0.390	0.506	0.435	0.364	0.443	0.522	0.398
1.50	0.271	0.385	0.499	0.429	0.359	0.438	0.517	0.394

Notes :

- (i) SPF values above 1.5 are considered to produce too great an error in estimation.
- (ii) Should the SPF value fall in between increments, adopt the multiplier related to the next larger SPF value.

(c) Combination of overhang and sidefin projections

For windows with both overhang and sidefin projections each external shading multiplier should be calculated separately as described in (a) and (b) and the smaller of the two values obtained should be used as the external shading multiplier in the OTTV calculations.

**Solar factor (SF)**

7.7 The solar factor for vertical surfaces at various orientations and that for horizontal surfaces should be obtained from Table 8. The solar factors have been calculated for the Hong Kong climate. Any sloping or angled wall or roof can be resolved into vertical and horizontal components. The vertical components of the sloping or angled wall or roof can be treated as a vertical surface with a solar factor at that respective orientation; whereas the horizontal component can be treated as a horizontal surface.

**Table 8 Solar Factor**

orientation	N	NE	E	SE	S	SW	W	NW
SF for vertical surface	104	138	168	197	191	202	175	138
orientation	NNE	ENE	ESE	SSE	SSW	WSW	WNW	NNW
SF for vertical surface	121	153	183	194	197	189	157	121
SF for horizontal surface	264							

**Equivalent temperature difference for roofs ( $TD_{EQr}$ )**

7.8 The equivalent temperature difference for roofs should take into account the roof mass and density and should be obtained from Table 9.

**Table 9 Equivalent Temperature Difference for Roofs**

Density of roof construction	less than 22 kg/m <sup>2</sup>	23-199 kg/m <sup>2</sup>	200-379 kg/m <sup>2</sup>	380-569 kg/m <sup>2</sup>	570 kg/m <sup>2</sup> or above
TD <sub>EQr</sub>	18.60	16.88	13.37	9.75	7.90

## 8. Windows and doors

Buildings should not have unenclosed doorways and entrances. For commercial buildings where heavy traffic of people is anticipated, self-closing doors without restrainers, revolving doors or other similar means of minimizing heat gain should be employed. Careful attention should also be paid to the sealing of windows to guard against leakage during service.

## 9. Submission of Information

9.1 Information and calculations required by the Building Authority are specified in the Building (Energy Efficiency) Regulation. Simplified version of OTTV calculations can be included in the first submission of building plans, provided that detailed calculations have to be submitted before consent to commence works will be granted. The following information and calculations should be submitted on the standard forms set out in the schedule to this Code :

- (a) Calculation of 'U' value of composite wall and roof and details of other component coefficients and parameters of OTTV on Form OTTV 1.
- (b) Window and rooflight schedule on Form OTTV 2.
- (c) OTTV calculations on Form OTTV 3 and Form OTTV 4.

9.2 OTTV calculations should be made to two places of decimals.

## Schedule of Standard Forms

Form OTTV 1

Form OTTV 2

Form OTTV 3

Form OTTV 4

Building (Energy Efficiency) Regulation  
Form OTTV 1

Calculation of 'U' Value of Composite Wall/Roof  
and Details of Other Values

Sheet No. A \_\_\_\_\_

BD Ref 2/\_\_\_\_/\_\_\_\_/\_\_\_\_

Building address \_\_\_\_\_

Physical data of Opaque \*Wall/Roof

Facade Orientation facing \_\_\_\_\_

Solar Factor (SF) is \_\_\_\_\_

*Wall/Roof Code No.	$*W_1/R_1$	$*W_2/R_2$	$*W_3/R_3$	$*W_4/R_4$
Location of Wall/Roof				
External Finish Material				
Conductivity W/m°C				
Density kg/m <sup>3</sup>				
Thickness m				
Absorptivity ( $\alpha$ )				
Intermediate component				
Conductivity W/m°C				
Density kg/m <sup>3</sup>				
Thickness m				
Intermediate component				
Conductivity W/m°C				
Density kg/m <sup>3</sup>				
Thickness m				
Intermediate component				
Conductivity W/m°C				
Density kg/m <sup>3</sup>				
Thickness m				
Intermediate component				
Conductivity W/m°C				
Density kg/m <sup>3</sup>				
Thickness m				
Internal Finish Material				
Conductivity W/m°C				
Density kg/m <sup>3</sup>				
Thickness m				
Absorptivity $\alpha$				
'U' value of composite *Wall/Roof				
Area of *Wall/Roof m <sup>2</sup>				
Density of composite *Wall/Roof kg/m <sup>2</sup>				
Equivalent temperature difference (TD <sub>EQ</sub> )				

Building (Energy Efficiency) Regulation  
Form OTTV 2

Window/Rooflight Schedule

Sheet No. B \_\_\_\_\_

BD Ref 2/\_\_\_\_/\_\_\_\_/\_\_\_\_

Building address \_\_\_\_\_

Physical data on \*window/rooflight

Facade Orientation facing \_\_\_\_\_

Solar Factor (SF) is \_\_\_\_\_

Window/Rooflight Code No.	$*F_1/RL_1$	$*F_2/RL_2$	$*F_3/RL_3$	$*F_4/RL_4$
Location of *Window/ Rooflight				
Glazing type				
Thickness m				
Shading Coefficient (SC)				
Type of shading device				
External Shading Multiplier (ESM)				
Area of glazing m <sup>2</sup>				

Physical data on \*window/rooflight

Facade Orientation facing \_\_\_\_\_

Solar Factor is \_\_\_\_\_

Window/Rooflight Code No.	$*F_1/RL_1$	$*F_2/RL_2$	$*F_3/RL_3$	$*F_4/RL_4$
Location of *Window/ Rooflight				
Glazing type				
Thickness m				
Shading Coefficient (SC)				
Type of shading device				
External Shading Multiplier (ESM)				
Area of glazing m <sup>2</sup>				

\* Delete as appropriate

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### Calculation of OTTV of Individual Facade in Building Envelope

BD Ref 2/\_\_\_\_/\_\_\_\_/\_\_\_\_

Facade Orientation facing \_\_\_\_\_.

Code No.	Description	$*A_w/A_r$	U	$\alpha$	$TD_{EQ}$	Sum
Subtotals			(A)	Heat Gain		(C)

Code No.	Description	*Af <sub>w</sub> /Af <sub>r</sub>	SC	ESM	SF	Sum
Subtotals			(B)	Heat Gain		

(D)

$$OTTV = \frac{C + D}{A + B} = \frac{\quad}{\quad} \text{ W/m}^2$$

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Building (Energy Efficiency) Regulation  
Form OTTV 4

Summary of OTTV of Building Envelope

Sheet No. D \_\_\_\_\_

BD Ref. 2/\_\_\_\_/\_\_\_\_/\_\_\_\_

Building address \_\_\_\_\_

Total Envelope Heat Gain (\* Tower/Podium)

Facade Orientation	Gross Area from Form OTTV 3	Gross Heat Gain from Form OTTV3
a.		
b.		
c.		
d.		
e.		
f.		
Subtotal	(E)	(G)
Roof		
a.		
b.		
Subtotal	(F)	(H)

$$* \text{ Tower/Podium Walls OTTV} = \frac{G}{E} = \text{_____ W/m}^2$$

$$* \text{ Tower/Podium Roofs OTTV} = \frac{H}{F} = \text{_____ W/m}^2$$

$$* \text{ Tower/Podium OTTV} = \frac{G + H}{E + F} = \text{_____ W/m}^2$$

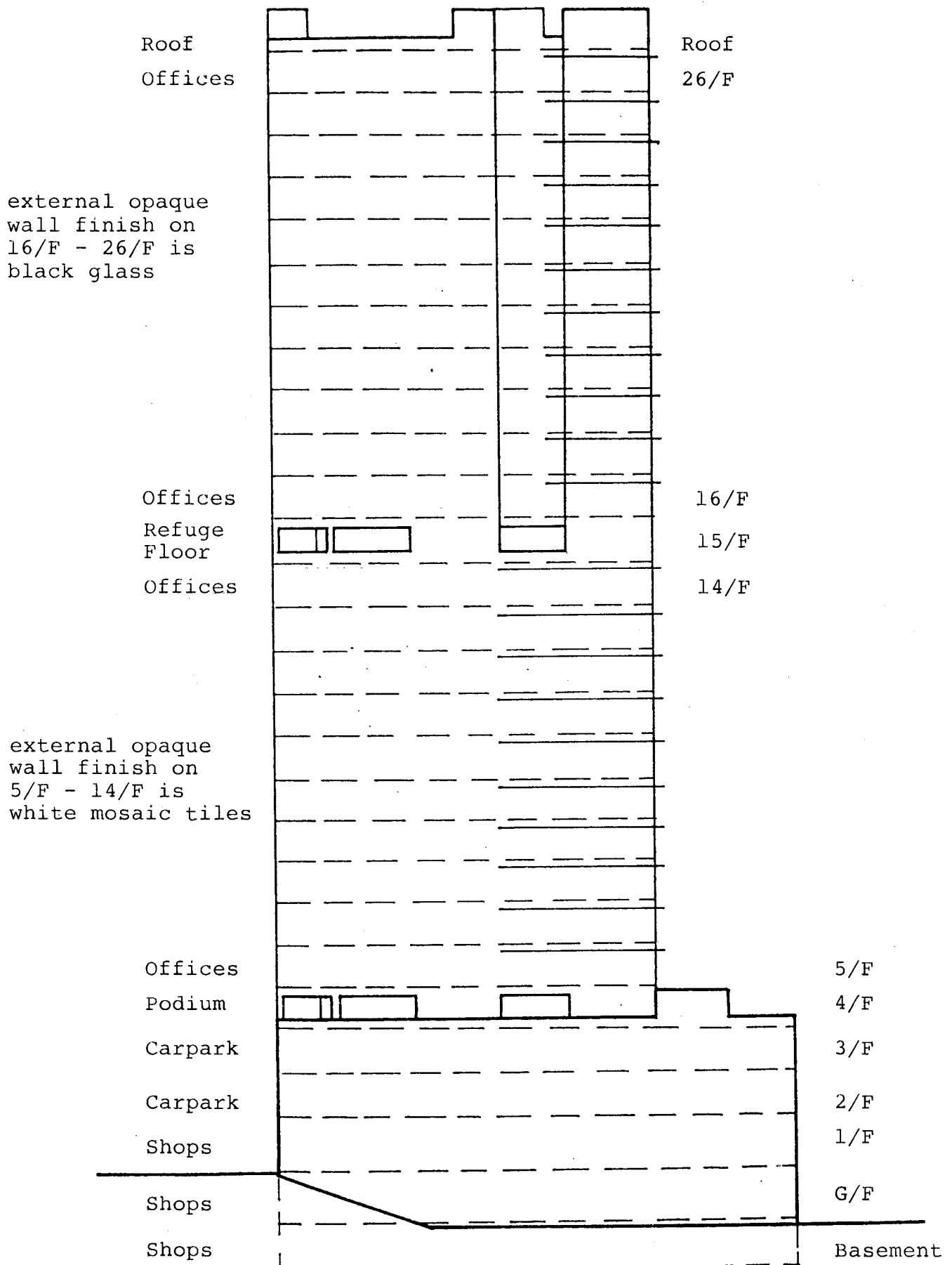
\* Delete as appropriate

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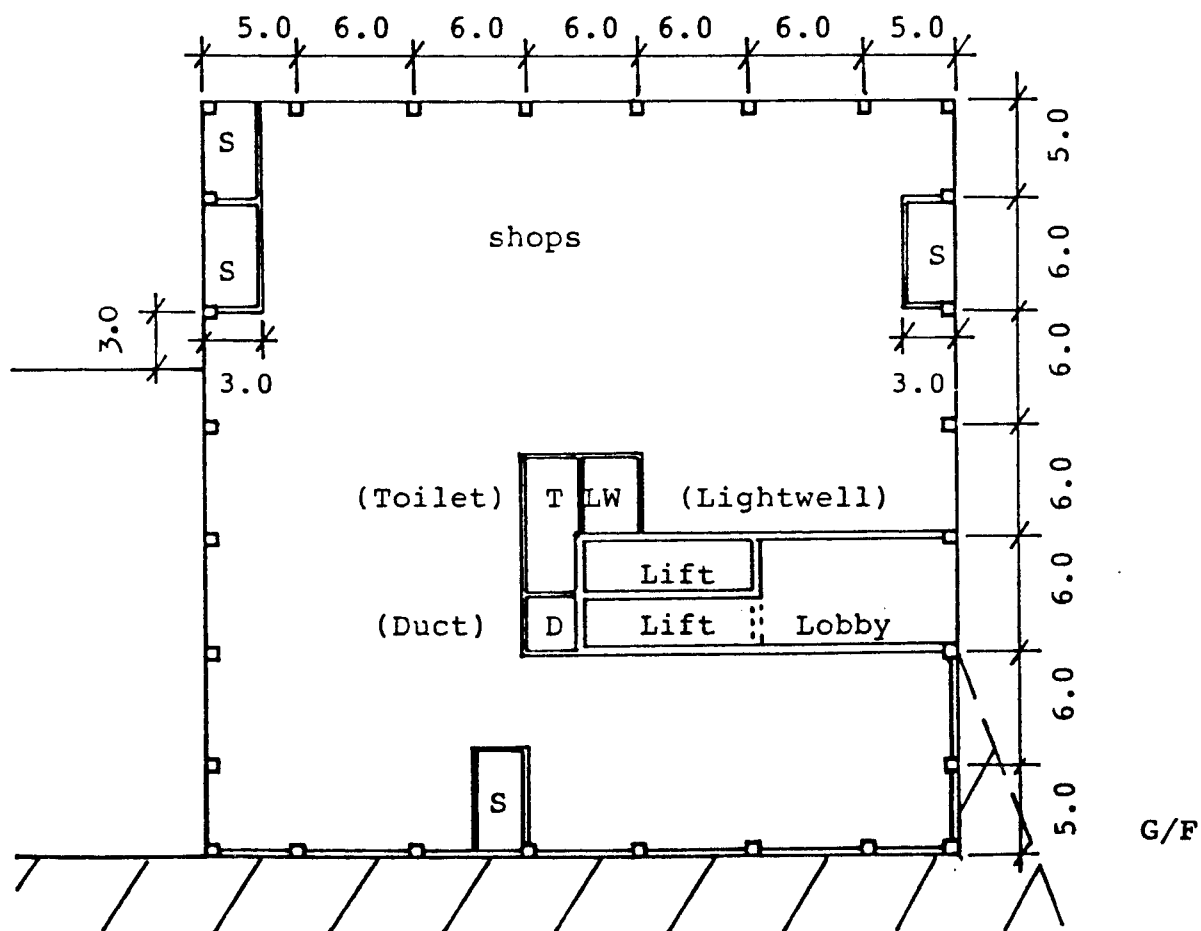
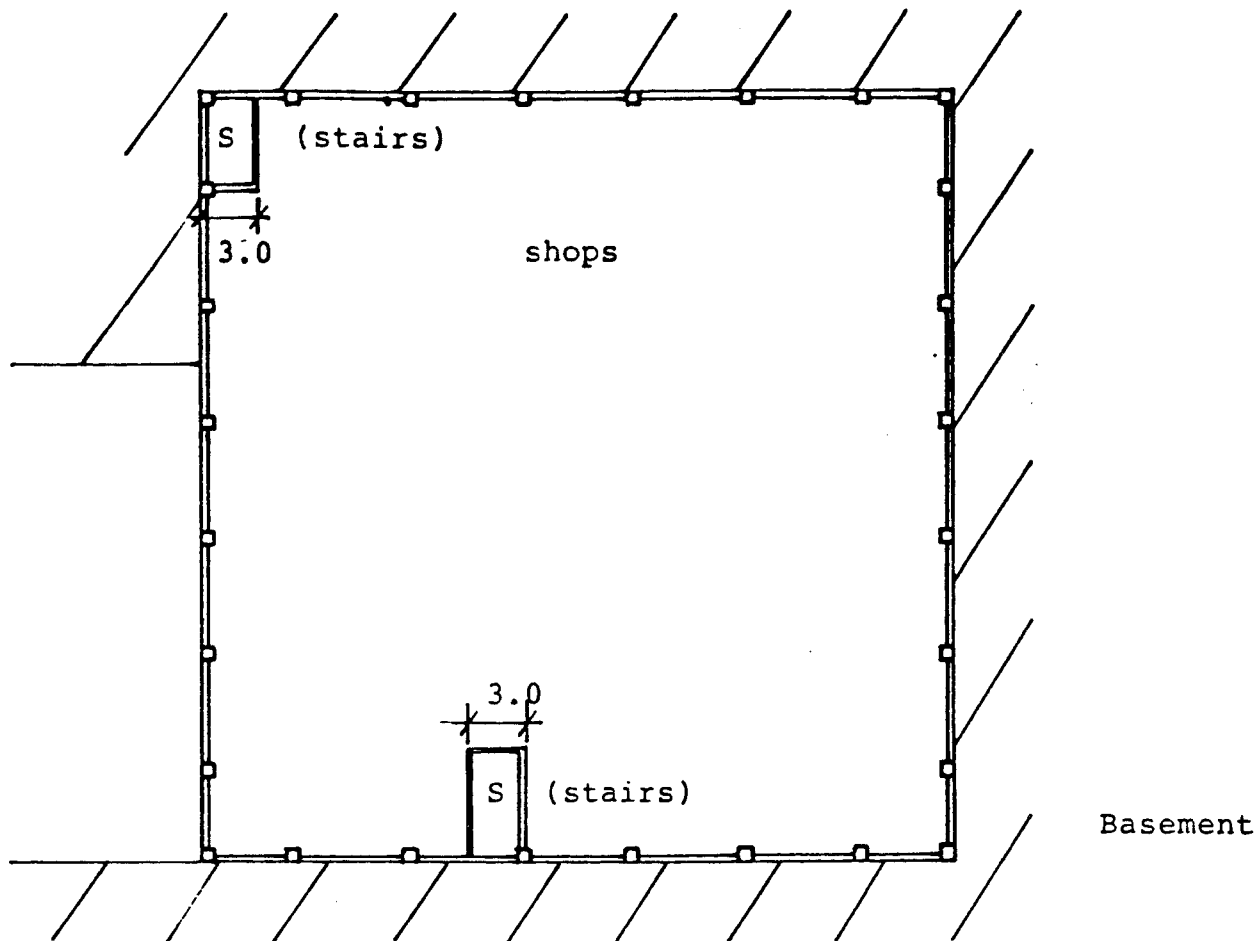
## Appendix A

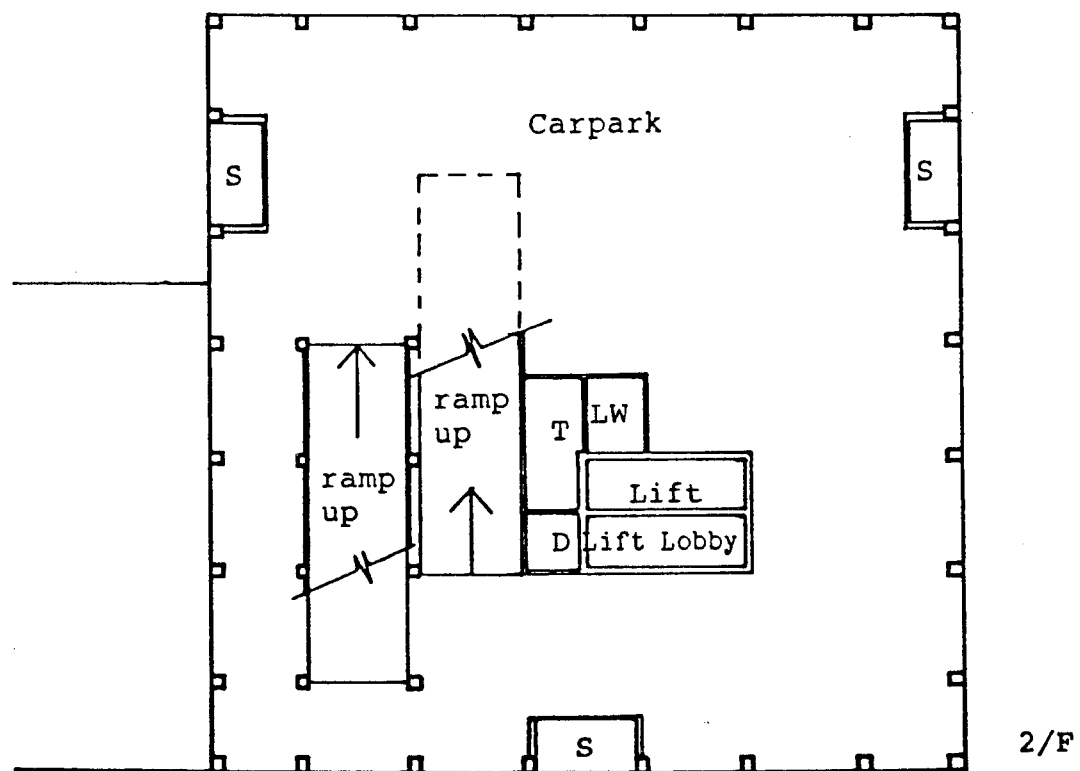
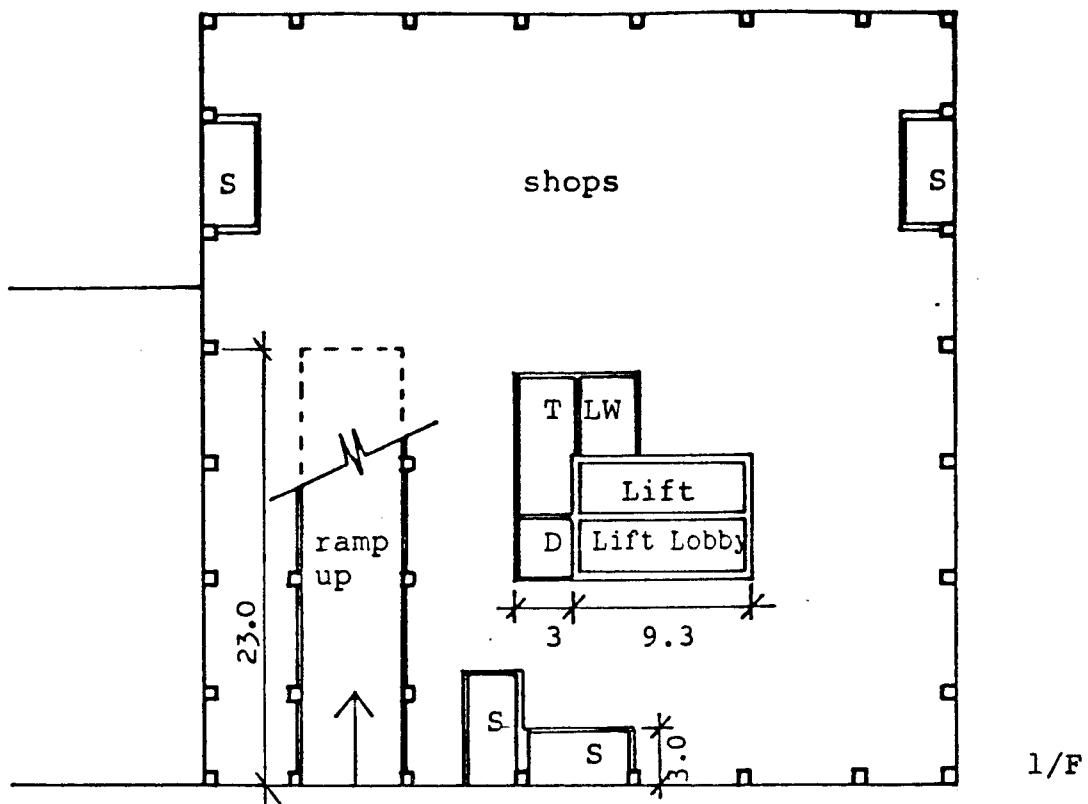
A sample of OTTV calculation for  
a typical commercial building

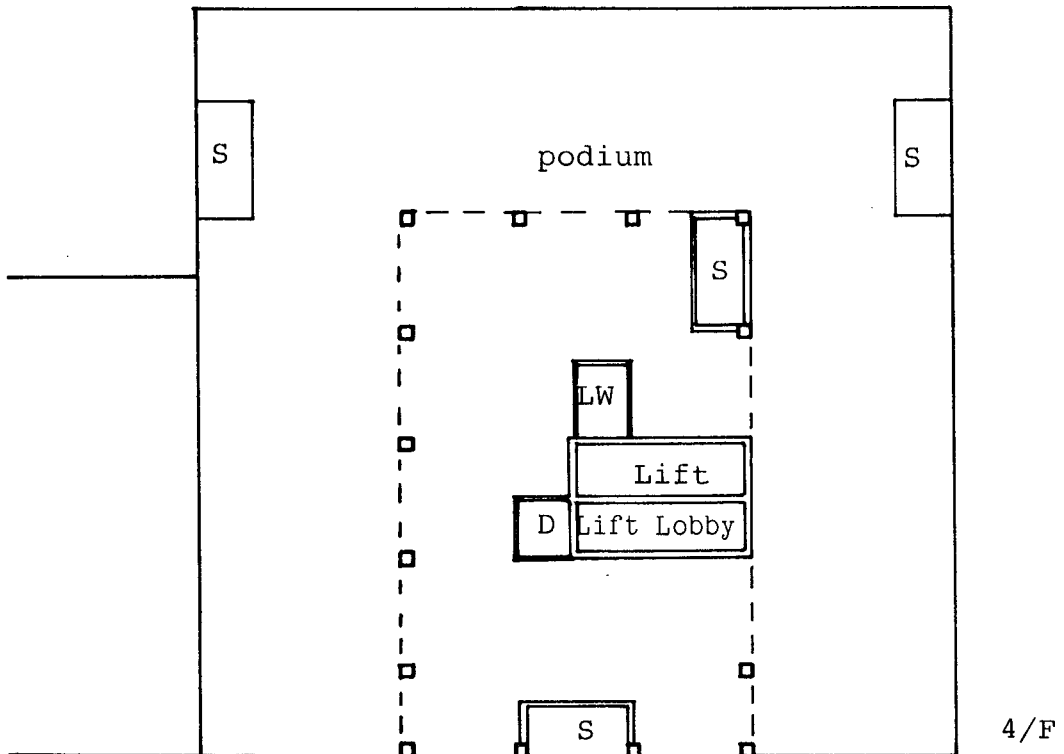
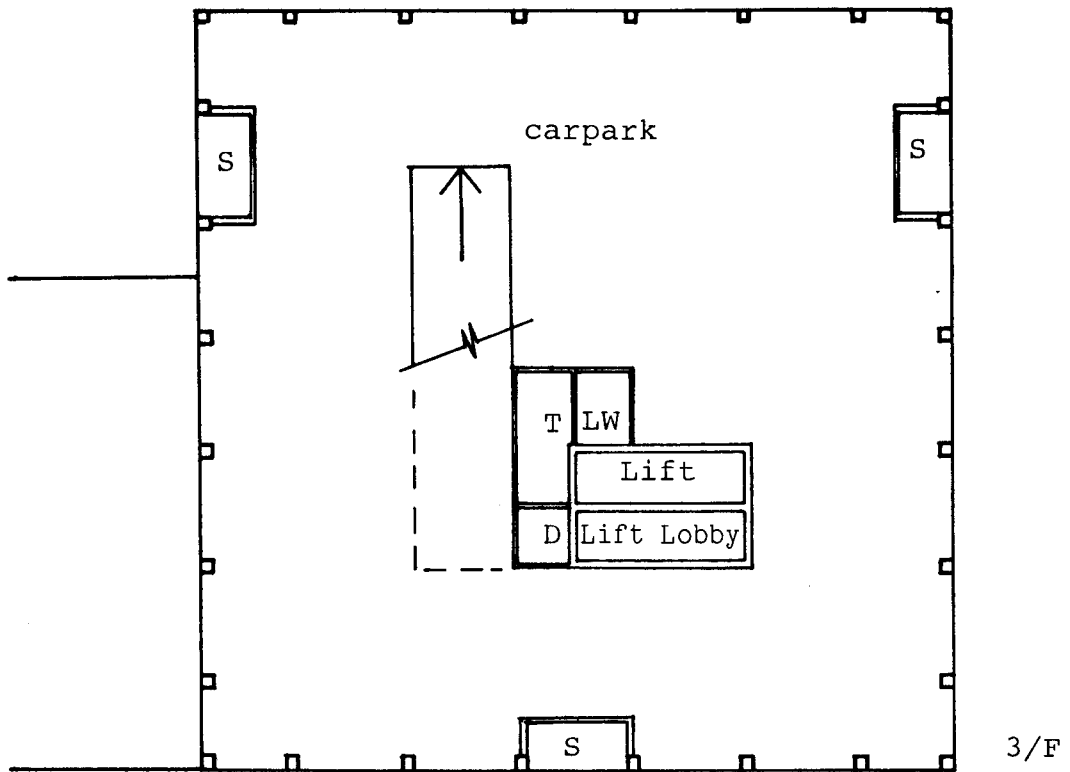
# Plans and Elevation of a Typical Commercial Building

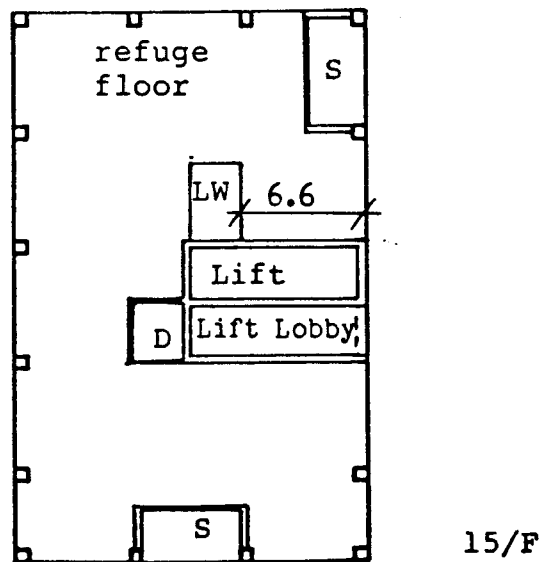
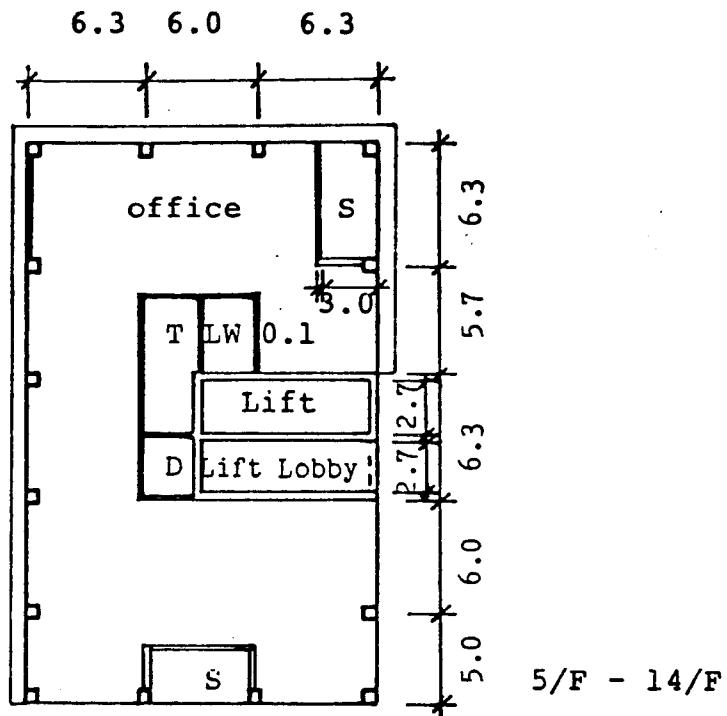


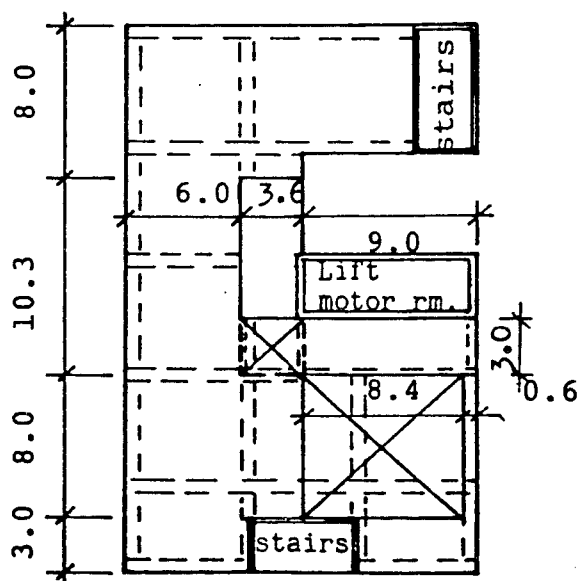
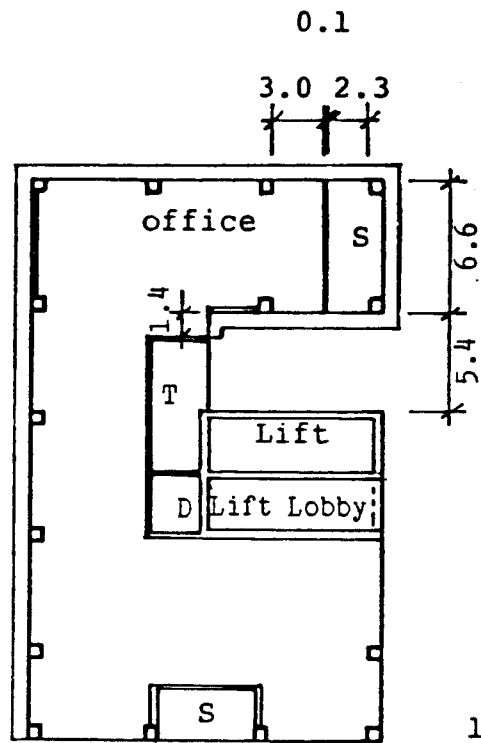
**East Elevation**





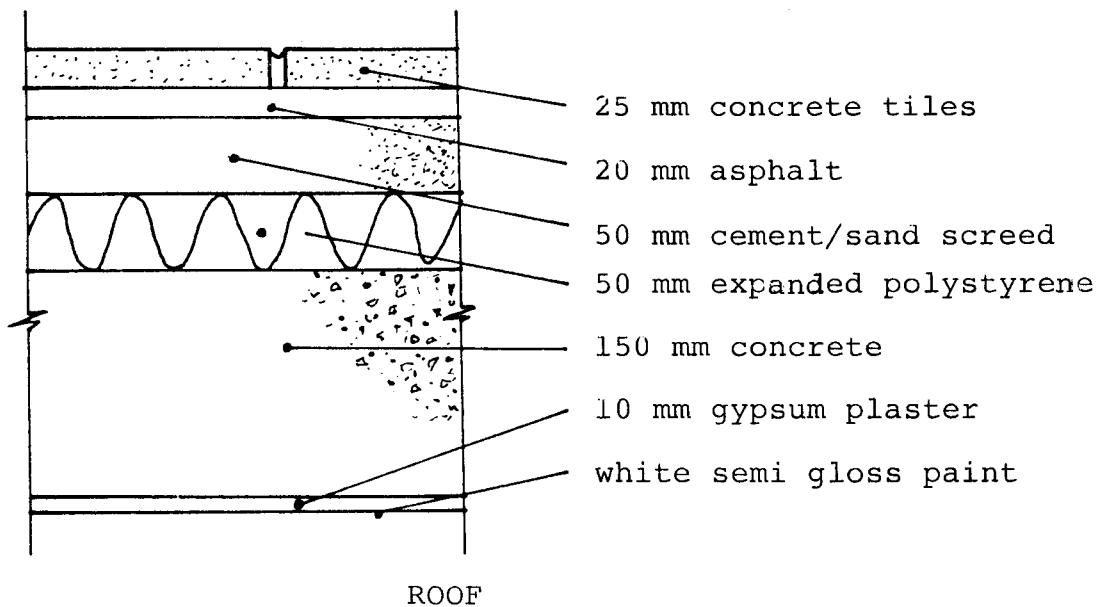
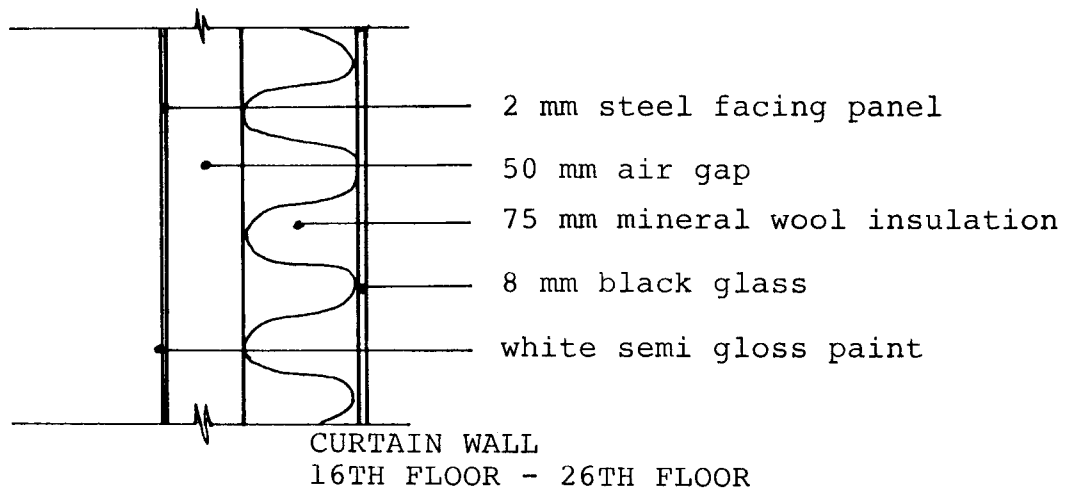
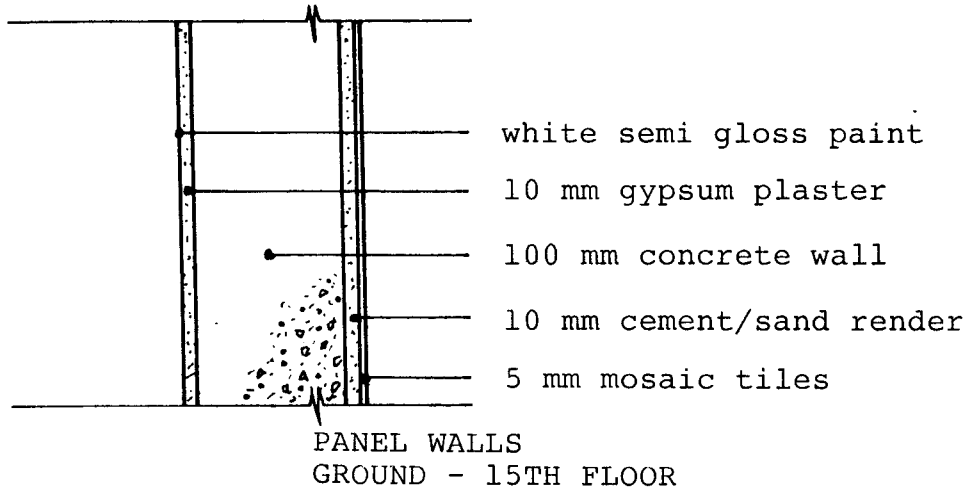


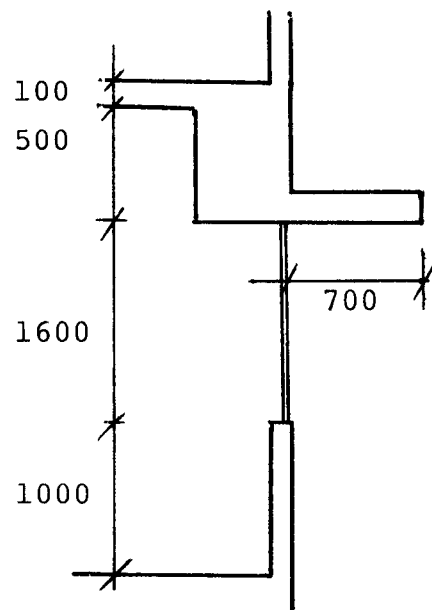






## Construction of Walls and Roof





TYPICAL SECTION  
5TH FLOOR - 26TH FLOOR

Gross Wall Calculations

Storey heights :

Ground and First Floors 4.0 m

2nd &amp; 3rd floors 3.5 m

4th to 26th floors 3.2 m

All columns 600 x 600 mm All beams 600 x 600 mm

East Elevation

P	G/F	$11.0 \times 4.0 \div 2 + 29 \times 4.0$	=	138.00 m <sup>2</sup>	
	1/F	$40 \times 4.0 + 23 \times 4 \times 0.5$	=	206.00 m <sup>2</sup>	344.00 m <sup>2</sup>

---

T	5/F-14/F	$23.0 \times 3.2 \times 10$	=	736.00 m <sup>2</sup>	
	16/F-26/F	$23.0 \times 3.2 \times 11$	=	809.60 m <sup>2</sup>	1,545.60 m <sup>2</sup>

---

	5/F-14/F	$6.3 \times 3.2 \times 10$	=	201.60 m <sup>2</sup>	
	16-26/F	$6.3 \times 3.2 \times 11$	=	221.76 m <sup>2</sup>	423.36 m <sup>2</sup>

---

North Elevation

P	G/F	$40.0 \times 4.0$	=	160.00 m <sup>2</sup>	
	1/F	$40.0 \times 4.0$	=	160.00 m <sup>2</sup>	320.00 m <sup>2</sup>

---

T	5-14/F	$18.6 \times 3.2 \times 10$	=	595.20 m <sup>2</sup>	
	16-26/F	$(18.6 + 9) \times 3.2 \times 11$	=	971.52 m <sup>2</sup>	1,566.72 m <sup>2</sup>

---

West Elevation

P	G/F	$40 \times 4.0$	=	160.00 m <sup>2</sup>	
	1/F	$40 \times 4.0 + 23 \times 4 \times 0.5$	=	206.00 m <sup>2</sup>	366.00 m <sup>2</sup>

---

T	5/F-14/F	$29.3 \times 3.2 \times 10$	=	937.60 m <sup>2</sup>	
	16/F-26/F	$29.3 \times 3.2 \times 11$	=	1,031.36 m <sup>2</sup>	1,968.96 m <sup>2</sup>

---

South Elevation

P	G/F	Nil	=	-	
	1/F	$40 \times 4.0 + (5.4 \times 23.35 - 5.4 \times 4.0)$	=	264.49 m <sup>2</sup>	264.49 m <sup>2</sup>

---

T	5/F-14/F	$18.6 \times 3.2 \times 10$	=	595.20 m <sup>2</sup>	
	16/F-26/F	$(18.6 + 9) \times 3.2 \times 11$	=	971.52 m <sup>2</sup>	1,566.72 m <sup>2</sup>

---

Window Schedule

Building Address

Typical Commercial Building

Orientation of Facade	Floor	Class Thickness m	Type	Sizes and no./floor m	Total area per floor m <sup>2</sup>
East	G/F	0.012	plain	(5.4 x 4 + 4.1) 3.4	87.38
	1/F	0.012	plain	(4.1x2 + 5.4x5) 3.4	119.68
	2-4/F	Nil	Nil	-	-
	5-14/F	0.008	tinted	(4.1+5.7+5.4x2) 1.6	32.96
	5-14/F	0.008	tinted	2.7 x 1.6	4.32
	15/F	Nil	tinted	-	-
	16-26/F	0.008	tinted	(4.1+5.7+1.4+5.4) 1.6 +3.9x0.8	29.68
	16-26/F	0.008	tinted	2.7 x 1.6	4.32
North	G/F	0.012	plain	(4.1+5.4x5+1.7+2.3) 3.4	119.34
	1/F	0.012	plain	(4.1x2+5.4x5) 3.4	119.68
	2-4/F	Nil	Nil	-	-
	5-14/F	0.008	tinted	(2.3+3.0+5.4x2) 1.6	25.76
	15/F	Nil	Nil	-	-
	16-26/F	0.008	tinted	(2.3+3.0+5.4x2) 1.6	25.76
West	G/F	0.012	plain	(4.1+5.4+2.7) 3.4	41.48
	1/F	0.012	plain	(4.1+5.4+2.7) 3.4	41.48
	2-4/F	Nil	Nil	-	-
	5-14/F	0.008	tinted	(5.4x3+4.1) 1.6	32.48
	15/F	Nil	Nil	-	-
	16-26/F	0.008	tinted	(5.4x3+4.1) 1.6	32.48
South	G/F	Nil	Nil	-	-
	1/F	0.012	plain	(4.1x2+2.7+2.6+5.4x3) 3.4	100.98
	2-4/F	Nil	Nil	-	-
	5-14/F	0.008	tinted	(5.4x3) 1.6	25.92
	15/F	Nil	Nil	-	-
	16-26/F	0.006	reflective	(5.4x3) 1.6	25.92
	16-26/F	0.008	tinted	(3.0 + 2.3) 1.6	8.48

East Elevation (Tower) Gross Wall Area  $1,545.60 + 423.36 = 1,968.96 \text{ m}^2$

Wall composite areas

Beams and Column Areas

5/F - 14/F  $[0.6 (11.0+5.7+6.3)+(0.6 \times 2.6 \times 4)] \times 10 = 200.40 \text{ m}^2$

15/F Nil

16/F - 26/F  $[0.6 (11.0+5.4+6.6)+(0.6 \times 2.6 \times 4)] \times 11 = 220.44 \text{ m}^2 \quad 420.84 \text{ m}^2$

---

Glazing Areas in 100 mm panel/curtain wall from Window Schedule

5/F - 14/F  $32.96 \times 10 = 329.60 \text{ m}^2$

15/F Nil

16/F - 26/F  $29.68 \times 11 = 326.48 \text{ m}^2 \quad 656.08 \text{ m}^2$

---

Glazing Area in 300 mm Structural Walls from Window Schedule

5/F - 14/F  $4.32 \times 10 = 43.20 \text{ m}^2$

15/F  $4.32 \times 11 = 47.52 \text{ m}^2 \quad 90.72 \text{ m}^2$

---

100 mm Panel/Curtain Wall Areas

5/F - 14/F  $736.00 - (200.40 + 329.60) = 206.00 \text{ m}^2$

15/F Nil

16/F - 26/F  $809.60 - (220.44 + 326.48) = 262.68 \text{ m}^2 \quad 468.68 \text{ m}^2$

---

300 mm Structural Walls to Lift & Lift Lobby

5/F - 14/F  $0.3 \times 3.2 \times 3 \times 10 = 28.80 \text{ m}^2$

16/F - 26/F  $0.3 \times 3.2 \times 3 \times 11 = 31.68 \text{ m}^2 \quad 60.48 \text{ m}^2$

---

300 mm Panel Walls to Lift & Lift Lobby

5/F - 14/F  $201.60 - (43.20 + 28.80) = 129.60$

16/F - 26/F  $221.76 - (47.52 + 31.68) = 142.56 \text{ m}^2 \quad 272.16 \text{ m}^2$

---

Lift shaft walls without gypsum plaster

5/F - 14/F  $2.7 \times 3.2 \times 10 = 86.40 \text{ m}^2$

16/F - 26/F  $2.7 \times 3.2 \times 11 = 95.04 \text{ m}^2 \quad 181.44 \text{ m}^2$

---

Fenestration between 5/F - 14/F

Total Glazing in 100 mm panel walls = 329.60

$(4.1 + 5.7) 1.6 \times 10 = 156.80$  unshaded

172.80 shaded

Fenestration between 16/F - 26/F

Total Glazing in curtain wall = 326.48

$[(4.1+5.7)1.6+(3.9 \times 0.8)] \times 11 = 206.80$  unshaded

119.68 shaded

'U' value of composite wall of columns and beams :-

G/F, 1/F, 5/F-14/F

W <sub>1</sub> for beam and column		Weight
external surface film	R <sub>o</sub> = 0.044	
5 mm white mosaic tiles	$\frac{0.005}{1.5} = 0.003$	0.005 x 2500 = 12.50
10 mm cement/sand render	$\frac{0.01}{0.72} = 0.014$	0.01 x 1860 = 18.60
600 mm concrete beam & column	$\frac{0.60}{2.16} = 0.278$	0.60 x 2400 = 1440.00
10 mm gypsum plaster	$\frac{0.01}{0.38} = 0.026$	0.01 x 1120 = 11.20
Internal surface film (absorptivity below 0.5)	R <sub>i</sub> = 0.299	
Totals	0.664	1482.30 kg/m <sup>2</sup>

$$U_w = \frac{1}{0.664} = 1.51 \text{ W/m}^2\text{°C} \quad (\text{for west podium wall without tiles or render 'U' value is } 1.55 \text{ W/m}^2\text{°C})$$

'U' value of composite wall panels :-

G/F, 1/F, 5/F-14/F

W <sub>3</sub> for wall panel		Weight
external surface film	R <sub>o</sub> = 0.044	
5 mm white mosaic tiles	= 0.003	0.005 x 2500 = 12.50
10 mm cement/sand render	= 0.014	0.01 x 1860 = 18.60
100 mm concrete panel	$\frac{0.1}{2.16} = 0.046$	0.10 x 2400 = 240.00
10 mm gypsum plaster	= 0.026	0.01 x 1120 = 11.20
Internal surface film	R <sub>i</sub> = 0.299	
Totals	0.432	282.30 kg/m <sup>2</sup>

$$U_w = \frac{1}{0.432} = 2.32 \text{ W/m}^2\text{°C} \quad (\text{for west podium wall without tiles and render 'U' value is } 2.41 \text{ W/m}^2\text{°C})$$

'U' value of composite columns and beams :-

16/F - 26/F

W <sub>2</sub> for beam and column		Weight
External surface film	R <sub>o</sub> = 0.044	
8 mm black glass	$\frac{0.008}{1.05} = 0.0076$	0.008 x 2500 = 20.00
50 mm Air space resistance (absorptivity above 0.5)	R <sub>a</sub> = 0.153	
600 mm concrete beam and column	$\frac{0.60}{2.16} = 0.278$	0.6 x 2400 = 1440.00
10 mm gypsum plaster	$\frac{0.01}{0.38} = 0.026$	0.01 x 1120 = 11.20
Internal surface film	R <sub>i</sub> = 0.299	
Totals	0.808	1471.20 kg/m <sup>2</sup>

$$U_w = \frac{1}{0.808} = 1.24 \text{ W/m}^2\text{°C}$$

'U' value of composite curtain wall panels :-

16/F - 26/F

W <sub>4</sub> for panel wall		Weight
External surface film	R <sub>o</sub> = 0.044	
8 mm black glass	$\frac{0.008}{1.05} = 0.0076$	0.008 x 2500 = 20.00
75 mm mineral wool felt insulation	$\frac{0.075}{0.039} = 1.923$	0.075 x 50 = 3.75
50 mm Air space resistance (absorptivity above 0.5)	R <sub>a</sub> = 0.153	-
2 mm pressed steel panel	$\frac{0.002}{50} = 0.00004$	0.002 x 7800 = 15.60
Internal surface film	R <sub>i</sub> = 0.299	
Totals	2.427	39.35 kg/m <sup>2</sup>

$$U_w = \frac{1}{2.427} = 0.41 \text{ W/m}^2\text{°C}$$

'U' value of structural walls :-

G/F, 1/F, 5/F-14/F

W <sub>5</sub> for wall panel		Weight
external surface film	Ro = 0.044	
5 mm white mosaic tiles	$\frac{0.005}{1.5} = 0.003$	0.005 x 2500 = 12.50
10 mm cement/sand render	$\frac{0.01}{0.72} = 0.014$	0.01 x 1860 = 18.60
300 mm concrete wall	$\frac{0.30}{2.16} = 0.139$	0.30 x 2400 = 720.00
10 mm gypsum plaster	$\frac{0.01}{0.38} = 0.026$	0.01 x 1120 = 11.20
Internal surface film (absorptivity below 0.5)	Ri = 0.299	
Totals	0.525	762.3 kg/m <sup>2</sup>

$$U_w = \frac{1}{0.525} = 1.91 \text{ W/m}^2\text{°C}$$

(for carpark ramp and walls without tiles or render 'U' value is 1.97 W/m<sup>2</sup>°C)  
(for lift wall without gypsum plaster 'U' value is 3.13 W/m<sup>2</sup>°C)

'U' value of structural walls :-

16/F-26/F

W <sub>6</sub> for beam and column		Weight
external surface film	Ro = 0.044	
8 mm black glass	$\frac{0.008}{1.05} = 0.0076$	0.008 x 2500 = 20.00
50 mm Air space resistance (absorptivity above 0.5)	Ra = 0.153	
300 mm concrete wall	$\frac{0.30}{2.16} = 0.139$	0.3 x 2400 = 720.00
10 mm gypsum plaster	$\frac{0.01}{0.38} = 0.026$	0.01 x 1120 = 11.20
Internal surface film	Ri = 0.299	
Totals	0.669	751.20 kg/m <sup>2</sup>

$$U_w = \frac{1}{0.669} = 1.50 \text{ W/m}^2\text{°C}$$

(for lift wall without gypsum plaster 'U' value is 2.16 W/m<sup>2</sup>°C)



'U' value of Lift Lobby wall :-

5/F - 14/F

W7 for beam and column		Weight
External surface film	Ro = 0.044	
5 mm white mosaic tiles	= 0.003	0.005 x 2500 = 12.50
10 mm cement/sand render	= 0.014	0.01 x 1860 = 18.60
*3.0 m concrete lobby wall	3.00 —— = 1.389 2.16	3.00 x 2400 = 7200.00
Totals	1.450	7231.10 kg/m <sup>2</sup>

$$U_w = \frac{1}{1.45} = 0.69 \text{ W/m}^2\text{°C} \quad * 3.0 \text{ m length assumed for simplicity}$$

'U' value of Lift Lobby wall :-

16/F - 26/F

W8 for beam and column		Weight
External surface film	Ro = 0.044	
8 mm black glass	= 0.0076	0.008 x 2500 = 20.00
50 mm Air space resistance (absorptivity above 0.5)	Ra = 0.153	
*3.0 m concrete lobby wall	= 1.389	3.00 x 2400 = 7200.00
Totals	= 1.594	7220.00 kg/m <sup>2</sup>

$$U_w = \frac{1}{1.594} = 0.63 \text{ W/m}^2\text{°C}$$

**Building (Energy Efficiency) Regulation**  
**Form OTTV 1**

**Calculation of 'U' Value of Composite Wall/Roof**  
**and Details of Other Values**

Sheet No. A 1BD Ref 2/      /      /     Building address Typical Commercial Building

Physical data of Opaque \*Wall/Roof

Facade Orientation facing East (Tower)Solar Factor (SF) is 168

*Wall/Roof Code No.	*W <sub>1</sub> /R <sub>1</sub>	*W <sub>2</sub> /R <sub>2</sub>	*W <sub>3</sub> /R <sub>3</sub>	*W <sub>4</sub> /R <sub>4</sub>
Location of Wall/Roof	Beams & Cols 5/F-14/F	Beams & Cols 16/F-26/F	Panel Curtain Walls 5/F-14/F	Panel Curtain Wall 16/F-26/F
External Finish Material				
Conductivity W/m°C	1.50	1.05	1.50	1.05
Density kg/m <sup>3</sup>	2500	2500	2500	2500
Thickness m	0.005	0.008	0.005	0.008
Absorptivity (α)	0.58	1.00	0.58	1.00
Intermediate component	cement render	air gap	cement render	mineral wool
Conductivity W/m°C	0.72		0.72	0.039
Density kg/m <sup>3</sup>	1860		1860	50
Thickness m	0.01	0.05	0.01	0.075
Intermediate component	r. concrete	r. concrete	r. concrete	air gap
Conductivity W/m°C	2.16	2.16	2.16	
Density kg/m <sup>3</sup>	2400	2400	2400	
Thickness m	0.60	0.60	0.10	0.05
Intermediate component				
Conductivity W/m°C				
Density kg/m <sup>3</sup>				
Thickness m				
Intermediate component				
Conductivity W/m°C				
Density kg/m <sup>3</sup>				
Thickness m				
Internal Finish Material		white semi gloss paint on gypsum plaster		white semi gloss paint on steel panel
Conductivity W/m°C	0.38	0.38	0.38	50
Density kg/m <sup>3</sup>	1120	1120	1120	7800
Thickness m	0.01	0.01	0.01	0.002
Absorptivity α	0.30	0.30	0.30	0.30
'U' value of composite *Wall/Roof	1.51	1.24	2.32	0.41
Area of *Wall/Roof m <sup>2</sup>	200.40	220.44	206.00	262.68
Density of composite *Wall/Roof kg/m <sup>2</sup>	1482	1471	282	39
Equivalent temperature difference (TD <sub>EQ</sub> )	2.40	2.40	5.01	6.68

\*Delete as appropriate

First issue April 1995

**Building (Energy Efficiency) Regulation**  
**Form OTTV 1**

**Calculation of 'U' Value of Composite Wall/Roof  
and Details of Other Values**

Sheet No. A 1(A)

BD Ref 2/\_\_\_/\_\_\_/\_\_\_

Building address Typical Commercial Building

Physical data of Opaque \*Wall/Roof

Facade Orientation facing East (Tower)Solar Factor (SF) is 168

*Wall/Roof Code No.	*W <sub>5</sub> /R <sub>5</sub>	*W <sub>6</sub> /R <sub>6</sub>	*W <sub>7</sub> /R <sub>7</sub>	*W <sub>8</sub> /R <sub>8</sub>
Location of Wall/Roof	300 Panel Walls 5/F-14/F	300 Panel Walls 16/F-26/F	Lift Lobby Wall 5/F-14/F	Lift Lobby Wall 16/F-26/F
External Finish Material	white mosaic tiles	black glass	white mosaic tiles	black glass
Conductivity W/m°C	1.50	1.05	1.50	1.05
Density kg/m <sup>3</sup>	2500	2500	2500	2500
Thickness m	0.005	0.008	0.005	0.008
Absorptivity (α)	0.58	1.00	0.58	1.00
Intermediate component	cement render	air gap	cement render	air gap
Conductivity W/m°C	0.72		0.72	
Density kg/m <sup>3</sup>	1860		1860	
Thickness m	0.01	0.05	0.01	0.05
Intermediate component	r. concrete	r. concrete	r. concrete	r. concrete
Conductivity W/m°C	2.16	2.16	2.16	2.16
Density kg/m <sup>3</sup>	2400	2400	2400	2400
Thickness m	0.30	0.30	3.00	3.00
Intermediate component				
Conductivity W/m°C				
Density kg/m <sup>3</sup>				
Thickness m				
Intermediate component				
Conductivity W/m°C				
Density kg/m <sup>3</sup>				
Thickness m				
Internal Finish Material	white semi gloss paint on gypsum plaster			
Conductivity W/m°C	0.38	0.38		
Density kg/m <sup>3</sup>	1120	1120		
Thickness m	0.01	0.01		
Absorptivity α	0.30	0.30		
'U' value of composite *Wall/Roof	1.91(3.13)	1.50(2.16)	0.69	0.63
Area of *Wall/Roof m <sup>2</sup>	43.20(86.4)	47.52(95.04)	28.80	31.68
Density of composite *Wall/Roof kg/m <sup>2</sup>	762(751)	751(740)	7231	7220
Equivalent temperature difference (TD <sub>EQ</sub> )	2.40	2.40	2.40	2.40

( ) Lift shaft walls without gypsum plaster

\*Delete as appropriate

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Building (Energy Efficiency) Regulation  
Form OTTV 2

Window/Rooflight Schedule

Sheet No. B 1

BD Ref 2/\_\_\_/\_\_\_/\_\_\_

Building address Typical Commercial Building

Physical data on \*window/rooflight

Facade Orientation facing East (Tower)

Solar Factor (SF) is 168

Window/Rooflight Code No.	*F <sub>1</sub> /RL <sub>1</sub>	*F <sub>2</sub> /RL <sub>2</sub>	*F <sub>3</sub> /RL <sub>3</sub>	*F <sub>4</sub> /RL <sub>4</sub>
Location of *Window/ Rooflight	5/F-14/F shaded	5/F-14/F unshaded	16/F-26/F shaded	16/F-26/F unshaded
Glazing type	tinted	tinted	tinted	tinted
Thickness m	0.008	0.008	0.008	0.008
Shading Coefficient (SC)	0.70	0.70	0.70	0.70
Type of shading device	solid overhang	-	aluminium foils	-
External Shading Multiplier (ESM)	0.7	-	0.7	-
Area of glazing m <sup>2</sup>	172.80	156.80	119.68	206.80

Physical data on \*window/rooflight

Facade Orientation facing East (Tower)

Solar Factor is 168

Window/Rooflight Code No.	*F <sub>5</sub> /RL <sub>5</sub>	*F <sub>6</sub> /RL <sub>6</sub>	*F <sub>7</sub> /RL <sub>7</sub>	*F <sub>8</sub> /RL <sub>8</sub>
Location of *Window/ Rooflight	5/F-14/F unshaded	16/F-26/F unshaded		
Glazing type	tinted	tinted		
Thickness m	0.008	0.008		
Shading Coefficient (SC)	0.70	0.70		
Type of shading device	-	-		
External Shading Multiplier (ESM)	-	-		
Area of glazing m <sup>2</sup>	43.20	47.52		

\* Delete as appropriate

**Building (Energy Efficiency) Regulation**  
**Form OTTV 3**

**Calculation of OTTV of Individual Facade in Building Envelope**

Sheet No. C 1

BD Ref 2/\_\_\_/\_\_\_/\_\_\_

Building address Typical Commercial Building

Facade Orientation facing East (Tower).

Opaque \*Walls/Roofs

Code No.	Description	*A <sub>w</sub> /A <sub>r</sub>	U	α	TD <sub>EQ</sub>	Sum
W1	Beams & Cols 5/F-14/F	200.40	1.51	0.58	2.40	421.22
W2	Beams & Cols 16/F-26/F	220.44	1.24	1.00	2.40	656.03
W3	Panel Curtain Walls 5/F-14/F	206.00	2.32	0.58	5.01	1,388.74
W4	Panel Curtain Walls 16/F-26/F	262.68	0.41	1.00	6.68	719.43
W5	300 Panel Walls 5/F-14/F	43.20	1.91	0.58	2.40	114.86
W5A	300 Lift Walls	86.40	3.13	0.58	2.40	376.44
W6	300 Panel Walls 16/F-26/F	47.52	1.50	1.00	2.40	171.07
W6A	300 Lift Walls	95.04	2.16	1.00	2.40	492.69
W7	Lift/Lobby wall 5/F-14/F	28.80	0.69	0.58	2.40	27.66
W8	Lift/Lobby wall 16/F-26/F	31.68	0.63	1.00	2.40	47.90
Subtotals		1,222.16	(A)	Heat Gain		4,416.04 (C)

Fenestration

Code No.	Description	*Af <sub>w</sub> /Af <sub>r</sub>	SC	ESM	SF	Sum
F1	5/F - 14/F shaded	172.80	0.70	0.7	168	14,224.90
F2	5/F - 14/F unshaded	156.80	0.70	-	168	18,439.68
F3	16/F - 26/F shaded	119.68	0.70	0.7	168	9,852.06
F4	16/F - 26/F unshaded	206.80	0.70	-	168	24,319.68
F5	5/F-14/F unshaded	43.20	0.70	-	168	5,080.32
F6	16/F - 26/F unshaded	47.52	0.70	-	168	5,588.35
Subtotals		746.80	(B)	Heat Gain		77,504.99 (D)

Gross Heat Gain (C + D) 81,921.03

Gross Area (A + B) 1,968.96

$$\text{OTTV} = \frac{C + D}{A + B} = \underline{41.61} \text{ W/m}^2$$

\* Delete as appropriate

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North Elevation (Tower)

Gross Wall Area

1,566.72 m<sup>2</sup>Wall composite areasBeams and Column Areas

5/F - 14/F	(0.6 x 18.6 + 0.6 x 2.6 x 4) 10	=	174.00 m <sup>2</sup>	
15/F	Nil	=	-	
16/F - 26/F	(0.6 x 18.6 + 0.6 x 2.6 x 4) 11	=	191.40 m <sup>2</sup>	365.40 m <sup>2</sup>
				<hr/>

300 mm Structural Wall to Lift

16/F-26/F	0.3 x 3.2 x 11	=	10.56 m <sup>2</sup>
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300 mm Structural Panel Walls to Lift

16/F-26/F	9.0 x 3.2 x 11 - 10.56	=	306.24 m <sup>2</sup>	316.80 m <sup>2</sup>
				<hr/>

Glazing Areas

5/F - 14/F	25.76 x 10	=	257.60 m <sup>2</sup>	
15/F	Nil	=	-	
16/F - 26/F	25.76 x 11	=	283.36 m <sup>2</sup>	540.96 m <sup>2</sup>
				<hr/>

100 mm Staircase Wall

5/F - 14/F	0.1 x 2.6 x 10	=	2.60 m <sup>2</sup>	
16/F - 26/F	0.1 x 2.6 x 11	=	2.86 m <sup>2</sup>	5.46 m <sup>2</sup>
				<hr/>

100 mm Wall Panel Areas

5/F - 14/F	595.20 - (174.00 + 257.60 + 2.60)	=	161.00 m <sup>2</sup>	
15/F	Nil	=	-	
16/F - 26/F	971.52 - (191.40 + 316.80 + 283.36 + 2.86)	=	177.10 m <sup>2</sup>	338.10 m <sup>2</sup>
				<hr/>

Building (Energy Efficiency) Regulation  
Form OTTV 1

Calculation of 'U' Value of Composite Wall/Roof  
and Details of Other Values

Sheet No. A 2

BD Ref 2/\_\_\_/\_\_\_/\_\_\_

Building address Typical Commercial Building

Physical data of Opaque \*Wall/Roof

Facade Orientation facing North (Tower)Solar Factor (SF) is 104

*Wall/Roof Code No.	*W <sub>1</sub> /R <sub>1</sub>	*W <sub>2</sub> /R <sub>2</sub>	*W <sub>3</sub> /R <sub>3</sub>	*W <sub>4</sub> /R <sub>4</sub>
Location of Wall/Roof	Beams & Coils 5/F-14/F	Beams & Coils 16/F-26/F	Panel Walls 5/F-14/F	Curtain Wall panel 16/F-26/F
External Finish Material	white mosaic tiles	black glass	white mosaic tiles	black glass
Conductivity W/m°C	1.50	1.05	1.50	1.05
Density kg/m <sup>3</sup>	2500	2500	2500	2500
Thickness m	0.005	0.008	0.005	0.008
Absorptivity (α)	0.58	1.00	0.58	1.00
Intermediate component	cement render	air gap	cement render	air gap
Conductivity W/m°C	0.72		0.72	0.039
Density kg/m <sup>3</sup>	1860		1860	50
Thickness m	0.01	0.05	0.01	0.075
Intermediate component	r. concrete	r. concrete	r. concrete	air gap
Conductivity W/m°C	2.16	2.16	2.16	
Density kg/m <sup>3</sup>	2400	2400	2400	
Thickness m	0.60	0.60	0.10	0.05
Intermediate component				
Conductivity W/m°C				
Density kg/m <sup>3</sup>				
Thickness m				
Intermediate component				
Conductivity W/m°C				
Density kg/m <sup>3</sup>				
Thickness m				
Internal Finish Material	white	semi gloss paint on gypsum plaster		white semi gloss paint on steel panel
Conductivity W/m°C	0.38	0.38	0.38	50
Density kg/m <sup>3</sup>	1120	1120	1120	7800
Thickness m	0.01	0.01	0.01	0.002
Absorptivity α	0.30	0.30	0.30	0.30
'U' value of composite *Wall/Roof	1.51	1.24	2.32	0.41
Area of *Wall/Roof m <sup>2</sup>	174.00	191.40	161.00	177.10
Density of composite *Wall/Roof kg/m <sup>2</sup>	1482	1471	282	39
Equivalent temperature difference (TD <sub>EQ</sub> )	1.70	1.70	2.72	3.38

\*Delete as appropriate

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**Building (Energy Efficiency) Regulation**  
**Form OTTV 1**

**Calculation of 'U' Value of Composite Wall/Roof  
and Details of Other Values**

Sheet No. A 3

BD Ref 2/\_\_\_/\_\_\_/\_\_\_

Building address Typical Commercial Building

Physical data of Opaque \*Wall/Roof

Facade Orientation facing North (Tower)Solar Factor (SF) is 104

*Wall/Roof Code No.	*W <sub>6</sub> /R <sub>6</sub>	*W <sub>7</sub> /R <sub>7</sub>	*W <sub>8</sub> /R <sub>8</sub>	*W <sub>8A</sub> /R <sub>8A</sub>
Location of Wall/Roof	300mm Structural Panel Walls 16/F-26/F	100mm Staircase wall 5/F-14/F	100mm Stair wall 16/F-26/F	300mm Structural Lift Walls 16/F-26/F
External Finish Material	black glass	white mosaic tiles	black glass	black glass
Conductivity W/m°C	1.05	1.50	1.05	1.05
Density kg/m <sup>3</sup>	2500	2500	2500	2500
Thickness m	0.008	0.005	0.008	0.008
Absorptivity (α)	1.00	0.58	1.00	1.00
Intermediate component	air gap	cement render	air gap	air gap
Conductivity W/m°C		0.72		
Density kg/m <sup>3</sup>		1860		
Thickness m	0.05	0.01	0.05	0.05
Intermediate component	r. concrete	r. concrete	r. concrete	r. concrete
Conductivity W/m°C	2.16	2.16	2.16	2.16
Density kg/m <sup>3</sup>	2400	2400	2400	2400
Thickness m	0.30	3.00	3.00	3.00
Intermediate component				
Conductivity W/m°C				
Density kg/m <sup>3</sup>				
Thickness m				
Intermediate component				
Conductivity W/m°C				
Density kg/m <sup>3</sup>				
Thickness m				
Internal Finish Material				
Conductivity W/m°C				
Density kg/m <sup>3</sup>				
Thickness m				
Absorptivity α				
'U' value of composite *Wall/Roof	2.16	0.69	0.63	0.63
Area of *Wall/Roof m <sup>2</sup>	306.24	2.60	2.86	10.56
Density of composite *Wall/Roof kg/m <sup>2</sup>	740	7231	7220	7220
Equivalent temperature difference (TD <sub>EQ</sub> )	1.70	1.70	1.70	1.70

\*Delete as appropriate

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Building (Energy Efficiency) Regulation  
Form OTTV 2

Window/Rooflight Schedule

Sheet No. B 2

BD Ref 2/\_\_\_/\_\_\_/\_\_\_

Building address Typical Commercial Building

Physical data on \*window/rooflight

Facade Orientation facing North (Tower)

Solar Factor (SF) is 104

Window/Rooflight Code No.	*F <sub>1</sub> /RL <sub>1</sub>	*F <sub>2</sub> /RL <sub>2</sub>	*F <sub>3</sub> /RL <sub>3</sub>	*F <sub>4</sub> /RL <sub>4</sub>
Location of *Window/ Rooflight	5/F-14/F shaded	16/F-26/F shaded		
Glazing type	tinted	tinted		
Thickness m	0.008	0.008		
Shading Coefficient (SC)	0.70	0.70		
Type of shading device	solid overhang	aluminium foils		
External Shading Multiplier (ESM)	0.80	0.80		
Area of glazing m <sup>2</sup>	257.60	283.36		

Physical data on \*window/rooflight

Facade Orientation facing \_\_\_\_\_

Solar Factor is \_\_\_\_\_

Window/Rooflight Code No.	*F <sub>1</sub> /RL <sub>1</sub>	*F <sub>2</sub> /RL <sub>2</sub>	*F <sub>3</sub> /RL <sub>3</sub>	*F <sub>4</sub> /RL <sub>4</sub>
Location of *Window/ Rooflight				
Glazing type				
Thickness m				
Shading Coefficient (SC)				
Type of shading device				
External Shading Multiplier (ESM)				
Area of glazing m <sup>2</sup>				

\* Delete as appropriate

**Building (Energy Efficiency) Regulation**  
**Form OTTV 3**

**Calculation of OTTV of Individual Facade in Building Envelope**

Sheet No. C 2

BD Ref 2/\_\_\_/\_\_\_/\_\_\_

Building address Typical Commercial Building

Facade Orientation facing North (Tower).

Opaque \*Walls/Roofs

Code No.	Description	*A <sub>w</sub> /A <sub>r</sub>	U	α	TD <sub>EQ</sub>	Sum	
W1	Beams & Col. 5/F-14/F	174.00	1.51	0.58	1.70	259.06	
W2	Beams & Col. 16/F-26/F	191.40	1.24	1.00	1.70	403.47	
W3	Panels Walls 5/F-14/F	161.00	2.32	0.58	2.72	589.27	
W4	Panels Walls 16/F-26/F	177.10	0.41	1.00	3.38	245.43	
W6	300 mm Structural Panel 16/F-26/F	306.24	2.16	1.00	1.70	1,124.51	
W7	100 mm Stair wall 5/F-14/F	2.60	0.69	0.58	1.70	1.77	
W8	100 mm Stair wall 16/F-26/F	2.86	0.63	1.00	1.70	3.06	
W8A	300 mm Lift wall 16/F-26/F	10.56	0.63	1.00	1.70	11.31	
Subtotals		1,025.76	(A)	Heat Gain		2,637.88	(C)

Fenestration

Code No.	Description	*Af <sub>w</sub> /Af <sub>r</sub>	SC	ESM	SF	Sum	
F1	5/F - 14/F	257.60	0.70	0.80	104	15,002.62	
F2	16/F - 26/F	283.36	0.70	0.80	104	16,502.89	
Subtotals		540.96	(B)	Heat Gain		31,505.51	(D)

Gross Heat Gain (C + D) 34,143.39

Gross Area (A + B) 1,566.72

$$\text{OTTV} = \frac{C + D}{A + B} = \frac{34,143.39}{1,566.72} = 21.79 \text{ W/m}^2$$

\* Delete as appropriate

West Elevation (Tower)

Gross Wall Area

1,968.96 m<sup>2</sup>Wall composite areasBeams and Column Areas

5/F - 14/F	(0.6 x 29.3 + 0.6 x 2.6 x 6) 10	=	269.40 m <sup>2</sup>	
15/F	Nil	=	-	
16/F - 26/F	(0.6 x 29.3 + 0.6 x 2.6 x 6) 11	=	296.34 m <sup>2</sup>	565.74 m <sup>2</sup>
				<hr/>

Glazing Areas

5/F - 14/F	32.48 x 10	=	324.80 m <sup>2</sup>	
15/F	Nil	=	-	
16/F - 26/F	32.48 x 11	=	357.28 m <sup>2</sup>	682.08 m <sup>2</sup>
				<hr/>

Wall Panel Areas

5/F - 14/F	937.60 - (269.40 + 324.80)	=	343.40 m <sup>2</sup>	
15/F	Nil	=	-	
16/F - 26/F	1,031.36 - (296.34 + 357.28)	=	377.74 m <sup>2</sup>	721.14 m <sup>2</sup>
				<hr/>

Building (Energy Efficiency) Regulation  
Form OTTV 1

Calculation of 'U' Value of Composite Wall/Roof  
and Details of Other Values

Sheet No. A 3

BD Ref 2/\_\_\_/\_\_\_/\_\_\_

Building address Typical Commercial Building

Physical data of Opaque \*Wall/Roof

Facade Orientation facing West (Tower)Solar Factor (SF) is 175

*Wall/Roof Code No.	*W <sub>1</sub> /R <sub>1</sub>	*W <sub>2</sub> /R <sub>2</sub>	*W <sub>3</sub> /R <sub>3</sub>	*W <sub>4</sub> /R <sub>4</sub>
Location of Wall/Roof	Beams & Cols 5/F-14/F	Beams & Cols 16/F-26/F	Panel Walls 5/F-14/F	Curtain Wall panel 16/F-26/F
External Finish Material	white mosaic tiles	black glass	white mosaic tiles	black glass
Conductivity W/m°C	1.50	1.05	1.50	1.05
Density kg/m <sup>3</sup>	2500	2500	2500	2500
Thickness m	0.005	0.008	0.005	0.008
Absorptivity (α)	0.58	1.00	0.58	1.00
Intermediate component	cement render	air gap	cement render	mineral felt
Conductivity W/m°C	0.72		0.72	0.039
Density kg/m <sup>3</sup>	1860		1860	50
Thickness m	0.01	0.05	0.01	0.075
Intermediate component	r. concrete	r. concrete	r. concrete	air gap
Conductivity W/m°C	2.16	2.16	2.16	
Density kg/m <sup>3</sup>	2400	2400	2400	
Thickness m	0.60	0.60	0.10	0.05
Intermediate component				
Conductivity W/m°C				
Density kg/m <sup>3</sup>				
Thickness m				
Intermediate component				
Conductivity W/m°C				
Density kg/m <sup>3</sup>				
Thickness m				
Internal Finish Material		white semi gloss paint on gypsum plaster		white semi gloss paint on steel panel
Conductivity W/m°C	0.38	0.38	0.38	50
Density kg/m <sup>3</sup>	1120	1120	1120	7800
Thickness m	0.01	0.01	0.01	0.002
Absorptivity α	0.30	0.30	0.30	0.30
'U' value of composite *Wall/Roof	1.51	1.24	2.32	0.41
Area of *Wall/Roof m <sup>2</sup>	269.40	296.34	343.40	377.74
Density of composite *Wall/Roof kg/m <sup>2</sup>	1482	1471	282	39
Equivalent temperature difference (TD <sub>EQ</sub> )	2.10	2.10	4.35	5.79

\*Delete as appropriate

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**Building (Energy Efficiency) Regulation**  
**Form OTTV 2**

**Window/Rooflight Schedule**

Sheet No. B 3

BD Ref 2/\_\_\_/\_\_\_/\_\_\_

Building address Typical Commercial Building

Physical data on \*window/rooflight

Facade Orientation facing West (Tower)

Solar Factor (SF) is 175

Window/Rooflight Code No.	*F <sub>1</sub> /RL <sub>1</sub>	*F <sub>2</sub> /RL <sub>2</sub>	*F <sub>3</sub> /RL <sub>3</sub>	*F <sub>4</sub> /RL <sub>4</sub>
Location of *Window/ Rooflight	5/F-14/F shaded	16/F-26/F shaded		
Glazing type	tinted	tinted		
Thickness m	0.008	0.008		
Shading Coefficient (SC)	0.70	0.70		
Type of shading device	solid overhang	aluminium foils		
External Shading Multiplier (ESM)	0.70	0.70		
Area of glazing m <sup>2</sup>	324.80	357.28		

Physical data on \*window/rooflight

Facade Orientation facing \_\_\_\_\_

Solar Factor is \_\_\_\_\_

Window/Rooflight Code No.	*F <sub>1</sub> /RL <sub>1</sub>	*F <sub>2</sub> /RL <sub>2</sub>	*F <sub>3</sub> /RL <sub>3</sub>	*F <sub>4</sub> /RL <sub>4</sub>
Location of *Window/ Rooflight				
Glazing type				
Thickness m				
Shading Coefficient (SC)				
Type of shading device				
External Shading Multiplier (ESM)				
Area of glazing m <sup>2</sup>				

\* Delete as appropriate

**Building (Energy Efficiency) Regulation**  
**Form OTTV 3**

**Calculation of OTTV of Individual Facade in Building Envelope**

Sheet No. C 3

BD Ref 2/\_\_\_/\_\_\_/\_\_\_

Building address Typical Commercial Building

Facade Orientation facing West (Tower).

Opaque \*Walls/Roofs

Code No.	Description	*A <sub>w</sub> /A <sub>r</sub>	U	α	TD <sub>EQ</sub>	Sum
W1	Beams & Col. 5/F-14/F	269.40	1.51	0.58	2.10	495.48
W2	Beams & Col. 16/F-26/F	296.34	1.24	1.00	2.10	771.67
W3	Panels Walls 5/F-14/F	343.40	2.32	0.58	4.35	2,010.04
W4	Curtain Wall Panels 16/F-26/F	377.74	0.41	1.00	5.79	896.72
Subtotals		1,286.88	(A)	Heat Gain		4,173.91 (C)

Fenestration

Code No.	Description	*Af <sub>w</sub> /Af <sub>r</sub>	SC	ESM	SF	Sum
F1	5/F - 14/F	324.80	0.70	0.70	175	27,851.60
F2	16/F - 26/F	357.28	0.70	0.70	175	30,636.76
Subtotals		682.08	(B)	Heat Gain		58,488.36 (D)

Gross Heat Gain (C + D) 62,662.27

Gross Area (A + B) 1,968.96

$$\text{OTTV} = \frac{C + D}{A + B} = \underline{31.83} \text{ W/m}^2$$

\* Delete as appropriate

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South Elevation (Tower)

Gross Wall Area

1,566.72 m<sup>2</sup>Wall composite areasBeam and Column Areas

5/F - 14/F	$(0.6 \times 18.6 + 0.6 \times 2.6 \times 4) \times 10$	=	174.00 m <sup>2</sup>	
15/F	Nil			
16/F - 26/F	$[(0.6 \times (18.6+9)+0.6 \times 2.6 \times 6)] \times 11$	=	285.12 m <sup>2</sup>	459.12 m <sup>2</sup>

---

Glazing Areas

5/F - 14/F	25.92 x 10	=	259.20 m <sup>2</sup>	
15/F	Nil			
16/F - 26/F	25.92 x 11	=	285.12 m <sup>2</sup>	
16/F - 26/F	8.48 x 11	=	93.28 m <sup>2</sup>	637.60 m <sup>2</sup>

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100 mm Stair case wall

16/F - 26/F	0.1 x 2.6 x 11	=	2.86 m <sup>2</sup>	2.86 m <sup>2</sup>
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Wall Panel Areas

5/F - 14/F	$595.20 - (174.00 + 259.20)$	=	162.00 m <sup>2</sup>	
15/F	Nil			
16/F - 26/F	$971.52 - (285.12+285.12+93.28+2.86)$	=	305.14 m <sup>2</sup>	467.14 m <sup>2</sup>

---

Fenestration between 16/F - 26/F

Total Glazing       $285.12 + 93.28 = 378.40 \text{ m}^2$

$(5.4 \times 3) \times 1.6 \times 11 = 285.12 \text{ m}^2$       Unshaded

93.28 m<sup>2</sup>      Shaded

Building (Energy Efficiency) Regulation  
Form OTTV 1

Calculation of 'U' Value of Composite Wall/Roof  
and Details of Other Values

Sheet No. A 4

BD Ref 2/\_\_\_/\_\_\_/\_\_\_

Building address Typical Commercial Building

Physical data of Opaque \*Wall/Roof

Facade Orientation facing South (Tower)Solar Factor (SF) is 191

*Wall/Roof Code No.	*W <sub>1</sub> /R <sub>1</sub>	*W <sub>2</sub> /R <sub>2</sub>	*W <sub>3</sub> /R <sub>3</sub>	*W <sub>4</sub> /R <sub>4</sub>
Location of Wall/Roof	Beams & Col 5/F-14/F	Beams & Col 16/F-26/F	Panel Walls 5/F-14/F	Curtain Wall panel 16/F-26/F
External Finish Material	white mosaic tiles	black glass	white mosaic tiles	black glass
Conductivity W/m°C	1.50	1.05	1.50	1.05
Density kg/m <sup>3</sup>	2500	2500	2500	2500
Thickness m	0.005	0.008	0.005	0.008
Absorptivity (α)	0.58	1.00	0.58	1.00
Intermediate component	cement render	air gap	cement render	mineral felt
Conductivity W/m°C	0.72		0.72	0.039
Density kg/m <sup>3</sup>	1860		1860	50
Thickness m	0.01	0.05	0.01	0.075
Intermediate component	r. concrete	r. concrete	r. concrete	air gap
Conductivity W/m°C	2.16	2.16	2.16	
Density kg/m <sup>3</sup>	2400	2400	2400	
Thickness m	0.60	0.60	0.10	0.05
Intermediate component				
Conductivity W/m°C				
Density kg/m <sup>3</sup>				
Thickness m				
Intermediate component				
Conductivity W/m°C				
Density kg/m <sup>3</sup>				
Thickness m				
Internal Finish Material	white semi gloss paint on gypsum plaster			white semi gloss paint on steel panel
Conductivity W/m°C	0.38	0.38	0.38	50
Density kg/m <sup>3</sup>	1120	1120	1120	7800
Thickness m	0.01	0.01	0.01	0.002
Absorptivity α	0.30	0.30	0.30	0.30
'U' value of composite *Wall/Roof	1.51	1.24	2.32	0.41
Area of *Wall/Roof m <sup>2</sup>	174.00	285.12	162.00	305.14
Density of composite *Wall/Roof kg/m <sup>2</sup>	1482	1471	282	39
Equivalent temperature difference (TD <sub>EQ</sub> )	1.40	1.40	3.60	5.01

\*Delete as appropriate

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Building (Energy Efficiency) Regulation  
Form OTTV 1

Calculation of 'U' Value of Composite Wall/Roof  
and Details of Other Values

Sheet No. A 4

BD Ref 2/\_\_\_/\_\_\_/\_\_\_

Building address Typical Commercial Building

Physical data of Opaque \*Wall/Roof

Facade Orientation facing South (Tower)

Solar Factor (SF) is 191

*Wall/Roof Code No.	*W <sub>g</sub> /R <sub>g</sub>
Location of Wall/Roof	16/F-26/F
External Finish Material	Staircase wall black glass
Conductivity W/m°C	1.05
Density kg/m <sup>3</sup>	2500
Thickness m	0.008
Absorptivity (α)	1.00
Intermediate component	air gap
Conductivity W/m°C	
Density kg/m <sup>3</sup>	
Thickness m	0.05
Intermediate component	r. concrete
Conductivity W/m°C	2.16
Density kg/m <sup>3</sup>	2400
Thickness m	3.00
Intermediate component	
Conductivity W/m°C	
Density kg/m <sup>3</sup>	
Thickness m	
Intermediate component	
Conductivity W/m°C	
Density kg/m <sup>3</sup>	
Thickness m	
Internal Finish Material	
Conductivity W/m°C	
Density kg/m <sup>3</sup>	
Thickness m	
Absorptivity α	
'U' value of composite *Wall/Roof	0.63
Area of *Wall/Roof m <sup>2</sup>	2.86
Density of composite *Wall/Roof kg/m <sup>2</sup>	7220
Equivalent temperature difference (TD <sub>EQ</sub> )	1.40

\*Delete as appropriate

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Building (Energy Efficiency) Regulation  
Form OTTV 2

Window/Rooflight Schedule

Sheet No. B 4

BD Ref 2/\_\_\_/\_\_\_/\_\_\_

Building address Typical Commercial Building

Physical data on \*window/rooflight

Facade Orientation facing South (Tower)

Solar Factor (SF) is 191

Window/Rooflight Code No.	*F <sub>1</sub> /RL <sub>1</sub>	*F <sub>2</sub> /RL <sub>2</sub>	*F <sub>3</sub> /RL <sub>3</sub>	*F <sub>4</sub> /RL <sub>4</sub>
Location of *Window/ Rooflight	5/F-14/F unshaded	16/F-26/F unshaded	16/F-26/F shaded	
Glazing type	tinted	reflective	tinted	
Thickness m	0.008	0.006	0.008	
Shading Coefficient (SC)	0.70	0.40	0.70	
Type of shading device			aluminium foils	
External Shading Multiplier (ESM)			0.70	
Area of glazing m <sup>2</sup>	259.20	285.12	93.28	

Physical data on \*window/rooflight

Facade Orientation facing \_\_\_\_\_

Solar Factor is \_\_\_\_\_

Window/Rooflight Code No.	*F <sub>1</sub> /RL <sub>1</sub>	*F <sub>2</sub> /RL <sub>2</sub>	*F <sub>3</sub> /RL <sub>3</sub>	*F <sub>4</sub> /RL <sub>4</sub>
Location of *Window/ Rooflight				
Glazing type				
Thickness m				
Shading Coefficient (SC)				
Type of shading device				
External Shading Multiplier (ESM)				
Area of glazing m <sup>2</sup>				

\* Delete as appropriate

Building (Energy Efficiency) Regulation  
Form OTTV 3

Calculation of OTTV of Individual Facade in Building Envelope

Sheet No. C 4

BD Ref 2/\_\_\_/\_\_\_/\_\_\_

Building address Typical Commercial Building

Facade Orientation facing South (Tower).

Opaque \*Walls/Roofs

Code No.	Description	*A <sub>w</sub> /A <sub>r</sub>	U	α	TD <sub>EQ</sub>	Sum
W1	Beams & Col. 5/F-14/F	174.00	1.51	0.58	1.40	213.34
W2	Beams & Col. 16/F-26/F	285.12	1.24	1.00	1.40	494.97
W3	Panels Walls 5/F-14/F	162.00	2.32	0.58	3.60	784.75
W4	Panels Walls 16/F-26/F	305.14	0.41	1.00	5.01	626.79
W8	Stair Walls 16/F-26/F	2.86	0.63	1.00	1.40	2.52
Subtotals		929.12	(A)	Heat Gain		2,122.37 (C)

Fenestration

Code No.	Description	*Af <sub>w</sub> /Af <sub>r</sub>	SC	ESM	SF	Sum
F1	5/F - 14/F unshaded	259.20	0.70		191	34,655.04
F2	16/F - 26/F unshaded	285.12	0.40		191	21,783.17
F3	16/F - 26/F shaded	93.28	0.70	0.70	191	8,730.08
Subtotals		637.60	(B)	Heat Gain		65,168.29 (D)

Gross Heat Gain (C + D) 67,290.66

Gross Area (A + B) 1,566.72

$$\text{OTTV} = \frac{C + D}{A + B} = \underline{42.95} \text{ W/m}^2$$

\* Delete as appropriate

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**Building (Energy Efficiency) Regulation**  
**Form OTTV 4**

**Summary of OTTV of Building Envelope**

Sheet No. D \_\_\_\_\_

BD Ref. 2/\_\_\_\_/\_\_\_\_/\_\_\_\_

Building address Typical Commercial Building

Total Envelope Heat Gain (\*Tower/Podium)

Facade Orientation	Gross Area from Form OTTV 3	Gross Heat Gain from Form OTTV 3
a. East	1,968.96	81,921.03
b. North	1,566.72	34,143.39
c. West	1,968.96	62,662.27
d. South	1,566.72	67,290.66
e.		
f.		
Subtotal	7,071.36 (E)	246,017.35 (G)
Roof		
a.	391.80	13,185.05
b.		
Subtotal	(F)	(H)

$$\text{Tower/Podium Walls OTTV} = \frac{G}{E} = \underline{34.79} \text{ W/m}^2$$

$$\text{Tower/Podium Roofs OTTV} = \frac{H}{F} = \underline{33.65} \text{ W/m}^2$$

$$\text{Tower/Podium OTTV} = \frac{G + H}{E + F} = \underline{34.73} \text{ W/m}^2$$

\* Delete as appropriate

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Accountable Roof AreasRoof

$$\text{Gross Area} = 6.0 \times 6.6 + 9.6 \times 8.0 + 6 \times 10.3 + 9.0 \times 3.0 + 18.6 \times 8.0 + (6.3 \times 3.0 \times 2) = 391.80 \text{ m}^2$$


---

$$\text{Glazed area} = 8.4 \times 8.0 = 67.20 \text{ m}^2$$

$$\text{Beam area} = [(15.6 \times 2) + (6.0 \times 2) + 18.6 + (6.3 \times 2) + (5.4 \times 9) + 1.4 + (4.1 \times 2) + (1.7 \times 2) + (2.4 \times 2 \times 0.5) + (3.6 \times 0.5)] \times 0.6 = 84.12 \text{ m}^2$$

$$\text{Lift Lobby walls} = 0.3 (9+2.7) = 3.51 \text{ m}^2$$

$$\text{Panel area} = 391.80 - 67.2 - 84.12 - 3.51 = 236.97 \text{ m}^2$$


---

15/F

$$\text{Gross Area} = 6.6 \times 5.4 + 2.4 \times 1.4 = 39.00 \text{ m}^2$$


---

$$\text{Glazed area} = \text{Nil}$$

$$\text{Beam area} = 0.6 (5.4 \times 2) = 6.48 \text{ m}^2$$

$$\text{Panel area} = 39.00 - 6.48 = 32.52 \text{ m}^2$$


---

Podium Roof

$$\text{Carpark under non-accountable} = \text{Nil}$$

'U' value of composite roof beams (and panels) :-

15/F and Roof

$R_1$ ( $R_2$ ) for beams (panels)	$r$	Weight
External surface film	$R_o = 0.055$	
25 mm concrete tiles	$\frac{0.025}{1.10} = 0.023$	$0.025 \times 2100 = 52.50$
20 mm asphalt	$\frac{0.02}{1.15} = 0.017$	$0.02 \times 2350 = 47.00$
50 mm cement/sand screed	$\frac{0.05}{0.72} = 0.069$	$0.05 \times 1860 = 93.00$
50 mm polystyrene insulation	$\frac{0.05}{0.034} = 1.471$	$0.05 \times 25 = 1.25$
600 mm r. concrete	$= 0.278$	$0.6 \times 2400 = 1440.00$
10 mm gypsum plaster	$= 0.026$	$0.01 \times 1120 = 11.20$
Internal surface film	$R_i = 0.801$	
Totals	2.740	1644.95 kg/m

$$U_R = \frac{1}{2.740} = 0.37 \text{ W/m}^2\text{°C}$$

for 150 mm slab 'U' value is  $0.40 \text{ W/m}^2\text{°C}$  and weight = 564.95 kg/m

for lift lobby walls say 3.0 m deep for ease of calculation,

'U' value is  $0.33 \text{ W/m}^2\text{°C}$  and weight = 7,393.75 kg/m

Building (Energy Efficiency) Regulation  
Form OTTV 1

Calculation of 'U' Value of Composite Wall/Roof  
and Details of Other Values

Sheet No. A 5

BD Ref 2/\_\_\_/\_\_\_/\_\_\_

Building address Typical Commercial Building

Physical data of Opaque \*Wall/Roof

Facade Orientation facing Roof (Tower)Solar Factor (SF) is 264

*Wall/Roof Code No.	*W <sub>1</sub> /R <sub>1</sub>	*W <sub>2</sub> /R <sub>2</sub>	*W <sub>3</sub> /R <sub>3</sub>
Location of Wall/Roof	Tower Roof Beam	Tower Roof Panels	Tower Roof Lift Walls
External Finish Material	concrete tiles	concrete tiles	concrete tiles
Conductivity W/m°C	1.10	1.10	1.10
Density kg/m <sup>3</sup>	2100	2100	2100
Thickness m	0.025	0.025	0.025
Absorptivity (α)	0.65	0.65	0.65
Intermediate component	asphalt	asphalt	asphalt
Conductivity W/m°C	1.15	1.15	1.15
Density kg/m <sup>3</sup>	2350	2350	2350
Thickness m	0.02	0.02	0.02
Intermediate component	cement/sand screed		
Conductivity W/m°C	0.72	0.72	0.72
Density kg/m <sup>3</sup>	1860	1860	1860
Thickness m	0.05	0.05	0.05
Intermediate component	expanded polystyrene		
Conductivity W/m°C	0.034	0.034	0.034
Density kg/m <sup>3</sup>	25	25	25
Thickness m	0.05	0.05	0.05
Intermediate component	r. concrete	r. concrete	r. concrete
Conductivity W/m°C	2.16	2.16	2.16
Density kg/m <sup>3</sup>	2400	2400	2400
Thickness m	0.60	0.15	3.00
Internal Finish Material	white semi gloss paint on gypsum plaster		
Conductivity W/m°C	0.38	0.38	
Density kg/m <sup>3</sup>	1120	1120	
Thickness m	0.01	0.01	
Absorptivity α	0.30	0.30	
'U' value of composite *Wall/Roof	0.37	0.40	0.33
Area of *Wall/Roof m <sup>2</sup>	84.12	236.97	3.51
Density of composite *Wall/Roof kg/m <sup>2</sup>	1645	565	7394
Equivalent temperature difference (TD <sub>EQ</sub> )	7.90	9.75	7.90

\*Delete as appropriate

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Building (Energy Efficiency) Regulation  
Form OTTV 2

Window/Rooflight Schedule

Sheet No. B 5

BD Ref 2/     /     /    

Building address Typical Commercial Building

Physical data on \*window/rooflight

Facade Orientation facing Roof (Tower)

Solar Factor (SF) is 264

Window/Rooflight Code No.	*F <sub>1</sub> /RL <sub>1</sub>	*F <sub>2</sub> /RL <sub>2</sub>	*F <sub>3</sub> /RL <sub>3</sub>	*F <sub>4</sub> /RL <sub>4</sub>
Location of *Window/ Rooflight	Roof			
Glazing type	tinted			
Thickness m	0.008			
Shading Coefficient (SC)	0.70			
Type of shading device	-			
External Shading Multiplier (ESM)				
Area of glazing m <sup>2</sup>	67.20			

Physical data on \*window/rooflight

Facade Orientation facing                     

Solar Factor is                     

Window/Rooflight Code No.	*F <sub>1</sub> /RL <sub>1</sub>	*F <sub>2</sub> /RL <sub>2</sub>	*F <sub>3</sub> /RL <sub>3</sub>	*F <sub>4</sub> /RL <sub>4</sub>
Location of *Window/ Rooflight				
Glazing type				
Thickness m				
Shading Coefficient (SC)				
Type of shading device				
External Shading Multiplier (ESM)				
Area of glazing m <sup>2</sup>				

\* Delete as appropriate



Building (Energy Efficiency) Regulation  
Form OTTV 3

Calculation of OTTV of Individual Facade in Building Envelope

Sheet No. C 5

BD Ref 2/\_\_\_/\_\_\_/\_\_\_

Building address Typical Commercial Building

Facade Orientation facing Roof (Tower).

Opaque \*Walls/Roofs

Code No.	Description	*A <sub>w</sub> /A <sub>r</sub>	U	α	TD <sub>EQ</sub>	Sum
R <sub>1</sub>	Tower Roof Beams	84.12	0.37	0.65	7.90	159.82
R <sub>2</sub>	Tower Roof Panels	236.97	0.40	0.65	9.75	600.72
R <sub>3</sub>	Tower Roof Stair & Lift Walls	3.51	0.33	0.65	7.90	5.95
Subtotals		324.60	(A)	Heat Gain		766.49 (C)

Fenestration

Code No.	Description	*Af <sub>w</sub> /Af <sub>r</sub>	SC	ESM	SF	Sum
RL <sub>1</sub>	Rooflight	67.20	0.70	-	264	12,418.56
Subtotals		67.20	(B)	Heat Gain		12,418.56 (D)

Gross Heat Gain (C + D) 13,185.05

Gross Area (A + B) 391.80

$$\text{OTTV} = \frac{C + D}{A + B} = \underline{33.65} \text{ W/m}^2$$

\* Delete as appropriate

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Building (Energy Efficiency) Regulation  
Form OTTV 1

Calculation of 'U' Value of Composite Wall/Roof  
and Details of Other Values

Sheet No. A 5(A)

BD Ref 2/\_\_\_/\_\_\_/\_\_\_

Building address Typical Commercial Building

Physical data of Opaque \*Wall/Roof

Facade Orientation facing Roof (15/F)Solar Factor (SF) is 264

*Wall/Roof Code No.	*W <sub>1</sub> /R <sub>1</sub>	*W <sub>2</sub> /R <sub>2</sub>
Location of Wall/Roof	15/F Beams	15/F Panels
External Finish Material	concrete tiles	concrete tiles
Conductivity W/m°C	1.10	1.10
Density kg/m <sup>3</sup>	2100	2100
Thickness m	0.025	0.025
Absorptivity (α)	0.65	0.65
Intermediate component	asphalt	asphalt
Conductivity W/m°C	1.15	1.15
Density kg/m <sup>3</sup>	2350	2350
Thickness m	0.02	0.02
Intermediate component	cement/sand screed	
Conductivity W/m°C	0.72	0.72
Density kg/m <sup>3</sup>	1860	1860
Thickness m	0.05	0.05
Intermediate component	expanded polystyrene	
Conductivity W/m°C	0.034	0.034
Density kg/m <sup>3</sup>	25	25
Thickness m	0.05	0.05
Intermediate component	r. concrete	r. concrete
Conductivity W/m°C	2.16	2.16
Density kg/m <sup>3</sup>	2400	2400
Thickness m	0.60	0.15
Internal Finish Material	white semi gloss paint on gypsum plaster	
Conductivity W/m°C	0.38	0.38
Density kg/m <sup>3</sup>	1120	1120
Thickness m	0.01	0.01
Absorptivity α	0.30	0.30
'U' value of composite *Wall/Roof	0.37	0.40
Area of *Wall/Roof m <sup>2</sup>	6.48	32.52
Density of composite *Wall/Roof kg/m <sup>2</sup>	1645	565
Equivalent temperature difference (TD <sub>EQ</sub> )	7.90	9.75

\*Delete as appropriate

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**Building (Energy Efficiency) Regulation**  
**Form OTTV 3**

**Calculation of OTTV of Individual Facade in Building Envelope**

Sheet No. C 5(A)

BD Ref 2/\_\_\_/\_\_\_/\_\_\_

Building address Typical Commercial Building

Facade Orientation facing Roof (15/F).

Opaque \*Walls/Roofs

Code No.	Description	*A <sub>w</sub> /A <sub>r</sub>	U	α	TD <sub>EQ</sub>	Sum
R <sub>3</sub>	15/F Beams	6.48	0.37	0.65	7.90	12.31
R <sub>4</sub>	15/F Panels	32.52	0.40	0.65	9.75	82.44
Subtotals		39.00	(A)	Heat Gain		94.75 (C)

Fenestration

Code No.	Description	*Af <sub>w</sub> /Af <sub>r</sub>	SC	ESM	SF	Sum
Subtotals			(B)	Heat Gain		(D)

Gross Heat Gain (C + D) 94.75

Gross Area (A + B) 39.00

$$\text{OTTV} = \frac{C + D}{A + B} = \underline{2.43} \text{ W/m}^2$$

\* Delete as appropriate

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East Elevation (Podium)

Gross Wall Area

344.00 m<sup>2</sup>Wall Composite AreasBeam and Column Areas

G/F	$0.6 \times 40.0 + 0.6 (3.4 \times 6 + 3.4 \times 0.5^*)$	=	37.26 m <sup>2</sup>	
1/F	$0.6 \times 40.0 + 0.6 (3.4 \times 8)$	=	40.32 m <sup>2</sup>	
1/F (Ramp)	$0.6 \times 23.0 + 0.6 (3.4 \times 5 \times 0.5)$	=	18.90 m <sup>2</sup>	
2/F - 4/F	Nil	=	-	96.48 m <sup>2</sup>

---

Glazing Areas

G/F	87.38 m <sup>2</sup>	=	87.38 m <sup>2</sup>	
1/F	119.68 m <sup>2</sup>	=	119.68 m <sup>2</sup>	
2/F - 4/F	Nil	=	-	207.06 m <sup>2</sup>

---

300 mm Retaining Wall

G/F	$138.00 - (37.26 + 87.38)$	=	13.36 m <sup>2</sup>
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300 mm Ramp Wall

1/F	$23 \times 4 \times 0.5 - 18.90$	=	27.1 m <sup>2</sup>
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\* Only half column considered to contribute

**Building (Energy Efficiency) Regulation**  
**Form OTTV 1**

**Calculation of 'U' Value of Composite Wall/Roof  
and Details of Other Values**

Sheet No. A 6

BD Ref 2/\_\_\_/\_\_\_/\_\_\_

Building address Typical Commercial Building

Physical data of Opaque \*Wall/Roof

Facade Orientation facing East (Podium)Solar Factor (SF) is 168

*Wall/Roof Code No.	*W <sub>1</sub> /R <sub>1</sub>	*W <sub>5</sub> /R <sub>5</sub>	*W <sub>5A</sub> /R <sub>5A</sub>	*W /R
Location of Wall/Roof	Beams & Cols G/F & 1/F	Retaining Wall G/F	Ramp Wall 1/F	
External Finish Material	white mosaic tiles			
Conductivity W/m°C	1.50	1.50	2.16	
Density kg/m <sup>3</sup>	2500	2500	2400	
Thickness m	0.005	0.005	0.30	
Absorptivity (α)	0.58	0.58	0.65	
Intermediate component	cement render			
Conductivity W/m°C	0.72	0.72		
Density kg/m <sup>3</sup>	1860	1860		
Thickness m	0.01	0.01		
Intermediate component	Reinforced concrete			
Conductivity W/m°C	2.16	2.16		
Density kg/m <sup>3</sup>	2400	2400		
Thickness m	0.60	0.30		
Intermediate component				
Conductivity W/m°C				
Density kg/m <sup>3</sup>				
Thickness m				
Intermediate component				
Conductivity W/m°C				
Density kg/m <sup>3</sup>				
Thickness m				
Internal Finish Material	white semi gloss paint on gypsum plaster			
Conductivity W/m°C	0.38	0.38	0.38	
Density kg/m <sup>3</sup>	1120	1120	1120	
Thickness m	0.01	0.01	0.01	
Absorptivity α	0.30	0.30	0.30	
'U' value of composite *Wall/Roof	1.51	1.91	1.97	
Area of *Wall/Roof m <sup>2</sup>	96.48	13.36	27.1	
Density of composite *Wall/Roof kg/m <sup>2</sup>	1482	762	731	
Equivalent temperature difference (TD <sub>EQ</sub> )	2.40	2.40	2.40	

\*Delete as appropriate

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**Building (Energy Efficiency) Regulation**  
**Form OTTV 2**

**Window/Rooflight Schedule**

Sheet No. B 6

BD Ref 2/\_\_\_/\_\_\_/\_\_\_

Building address Typical Commercial Building

Physical data on \*window/rooflight

Facade Orientation facing East (Podium)

Solar Factor (SF) is 168

Window/Rooflight Code No.	*F <sub>1</sub> /RL <sub>1</sub>	*F <sub>2</sub> /RL <sub>2</sub>	*F <sub>3</sub> /RL <sub>3</sub>	*F <sub>4</sub> /RL <sub>4</sub>
Location of *Window/ Rooflight	G/F&l/F unshaded			
Glazing type	plain			
Thickness m	0.012			
Shading Coefficient (SC)	0.90			
Type of shading device	-			
External Shading Multiplier (ESM)	-			
Area of glazing m <sup>2</sup>	207.06			

Physical data on \*window/rooflight

Facade Orientation facing \_\_\_\_\_

Solar Factor is \_\_\_\_\_

Window/Rooflight Code No.	*F <sub>1</sub> /RL <sub>1</sub>	*F <sub>2</sub> /RL <sub>2</sub>	*F <sub>3</sub> /RL <sub>3</sub>	*F <sub>4</sub> /RL <sub>4</sub>
Location of *Window/ Rooflight				
Glazing type				
Thickness m				
Shading Coefficient (SC)				
Type of shading device				
External Shading Multiplier (ESM)				
Area of glazing m <sup>2</sup>				

\* Delete as appropriate

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**Building (Energy Efficiency) Regulation**  
**Form OTTV 3**

**Calculation of OTTV of Individual Facade in Building Envelope**

Sheet No. C 6

BD Ref 2/\_\_\_/\_\_\_/\_\_\_

Building address Typical Commercial Building

Facade Orientation facing East (Podium).

Opaque \*Walls/Roofs

Code No.	Description	*A <sub>w</sub> /A <sub>r</sub>	U	α	TD <sub>EQ</sub>	Sum
W1	Beams & Col. G/F&l/F	96.48	1.51	0.58	2.40	202.79
W5	Panels G/F&l/F	13.36	1.91	0.58	2.40	35.52
W5	Ramp Wall l/F	27.10	1.97	0.65	2.40	83.28
Subtotals		136.94	(A)	Heat Gain		321.59 (C)

Fenestration

Code No.	Description	*Af <sub>w</sub> /Af <sub>r</sub>	SC	ESM	SF	Sum
F1	G/F & l/F	207.06	0.90	-	168	31,307.47
Subtotals		207.06	(B)	Heat Gain		31,307.47 (D)

Gross Heat Gain (C + D) 31,629.06

Gross Area (A + B) 344.00

$$\text{OTTV} = \frac{C + D}{A + B} = \underline{91.95} \text{ W/m}^2$$

\* Delete as appropriate

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North Elevation (Podium)

Gross Wall Area

320.00 m<sup>2</sup>Wall Composite AreasBeam and Column Areas

G/F	$0.6 \times 40 + 0.6 \times 3.4 \times 8$	=	40.32 m <sup>2</sup>	
1/F	$0.6 \times 40 + 0.6 \times 3.4 \times 8$	=	40.32 m <sup>2</sup>	80.64 m <sup>2</sup>
				<hr/>

100 mm Stair Wall

G/F Stair Wall	$0.1 \times 3.4$	=	0.34 m <sup>2</sup>
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Glazing Areas

G/F	119.34	=	119.34 m <sup>2</sup>	
1/F	119.68	=	119.68 m <sup>2</sup>	239.02 m <sup>2</sup>
				<hr/>

Panel Areas

G/F	$160.00 - (40.32 + 119.34 + 0.34)$	=	0	
1/F	$160.00 - (40.32 + 119.68)$	=	0	0
				<hr/>



Building (Energy Efficiency) Regulation  
Form OTTV 1

Calculation of 'U' Value of Composite Wall/Roof  
and Details of Other Values

Sheet No. A 7BD Ref 2/     /     /    Building address Typical Commercial Building

Physical data of Opaque \*Wall/Roof

Facade Orientation facing North (Podium)Solar Factor (SF) is 104

*Wall/Roof Code No.	*W <sub>1</sub> /R <sub>1</sub>	*W <sub>7</sub> /R <sub>7</sub>	*W <sub>3</sub> /R <sub>3</sub>	*W <sub>4</sub> /R <sub>4</sub>
Location of Wall/Roof	Beams & Cols G/F & 1/F	Stair Wall G/F		
External Finish Material	white mosaic tiles			
Conductivity W/m°C	1.50	1.50		
Density kg/m <sup>3</sup>	2500	2500		
Thickness m	0.005	0.005		
Absorptivity (α)	0.58	0.58		
Intermediate component	cement render			
Conductivity W/m°C	0.72	0.72		
Density kg/m <sup>3</sup>	1860	1860		
Thickness m	0.01	0.01		
Intermediate component	Reinforced concrete			
Conductivity W/m°C	2.16	2.16		
Density kg/m <sup>3</sup>	2400	2400		
Thickness m	0.60	3.00		
Intermediate component				
Conductivity W/m°C				
Density kg/m <sup>3</sup>				
Thickness m				
Intermediate component				
Conductivity W/m°C				
Density kg/m <sup>3</sup>				
Thickness m				
Internal Finish Material	white semi gloss paint on gypsum plaster			
Conductivity W/m°C	0.38			
Density kg/m <sup>3</sup>	1120			
Thickness m	0.01			
Absorptivity α	0.30			
'U' value of composite *Wall/Roof	1.51	0.69		
Area of *Wall/Roof m <sup>2</sup>	80.64	0.34		
Density of composite *Wall/Roof kg/m <sup>2</sup>	1482	7231		
Equivalent temperature difference (T <sub>EQ</sub> )	1.70	1.70		

\*Delete as appropriate

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Building (Energy Efficiency) Regulation  
Form OTTV 2

Window/Rooflight Schedule

Sheet No. B 7

BD Ref 2/\_\_\_/\_\_\_/\_\_\_

Building address Typical Commercial Building

Physical data on \*window/rooflight

Facade Orientation facing North (Podium)

Solar Factor (SF) is 104

Window/Rooflight Code No.	*F <sub>1</sub> /RL <sub>1</sub>	*F <sub>2</sub> /RL <sub>2</sub>	*F <sub>3</sub> /RL <sub>3</sub>	*F <sub>4</sub> /RL <sub>4</sub>
Location of *Window/ Rooflight	G/F&l/F unshaded			
Glazing type	plain			
Thickness m	0.012			
Shading Coefficient (SC)	0.90			
Type of shading device	-			
External Shading Multiplier (ESM)	-			
Area of glazing m <sup>2</sup>	239.02			

Physical data on \*window/rooflight

Facade Orientation facing \_\_\_\_\_

Solar Factor is \_\_\_\_\_

Window/Rooflight Code No.	*F <sub>1</sub> /RL <sub>1</sub>	*F <sub>2</sub> /RL <sub>2</sub>	*F <sub>3</sub> /RL <sub>3</sub>	*F <sub>4</sub> /RL <sub>4</sub>
Location of *Window/ Rooflight				
Glazing type				
Thickness m				
Shading Coefficient (SC)				
Type of shading device				
External Shading Multiplier (ESM)				
Area of glazing m <sup>2</sup>				

\* Delete as appropriate

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**Building (Energy Efficiency) Regulation**  
**Form OTTV 3**

**Calculation of OTTV of Individual Facade in Building Envelope**

Sheet No. C 7

BD Ref 2/\_\_\_/\_\_\_/\_\_\_

Building address Typical Commercial Building

Facade Orientation facing North (Podium).

Opaque \*Walls/Roofs

Code No.	Description	*A <sub>w</sub> /A <sub>r</sub>	U	α	TD <sub>EQ</sub>	Sum
W1	Beams & Cols. G/F&l/F	80.64	1.51	0.58	1.70	120.06
W7	Stair Wall G/F	0.34	0.69	0.58	1.70	0.23
Subtotals		80.98	(A)	Heat Gain		120.29 (C)

Fenestration

Code No.	Description	*Af <sub>w</sub> /Af <sub>r</sub>	SC	ESM	SF	Sum
F1	G/F & l/F	239.02	0.90	-	104	22,372.27
Subtotals		239.02	(B)	Heat Gain		22,372.27 (D)

Gross Heat Gain (C + D) 22,492.56

Gross Area (A + B) 320.00

$$\text{OTTV} = \frac{C + D}{A + B} = \underline{70.29} \text{ W/m}^2$$

\* Delete as appropriate

<u>West Elevation (Podium)</u>	Gross Wall Area	366.00 m <sup>2</sup>
	(With tiles = 112 m <sup>2</sup> )	
	(Party wall = 208 m <sup>2</sup> )	

Wall Composite AreasBeam and Column Areas (with tiles)

G/F	$0.6 \times 14 + 0.6 (3.4 \times 3)$	= 14.52 m <sup>2</sup>	
1/F	$0.6 \times 14 + 0.6 (3.4 \times 3)$	= 14.52 m <sup>2</sup>	29.04 m <sup>2</sup>
		<hr/>	

300 mm Ramp Wall

1/F	$23 \times 4 \times 0.5 - 18.9$	= 27.1 m <sup>2</sup>
-----	---------------------------------	-----------------------

Glazing Areas

G/F	41.48	= 41.48 m <sup>2</sup>	
1/F	41.48	= 41.48 m <sup>2</sup>	82.96 m <sup>2</sup>
		<hr/>	

Beam and Column Areas (Party Wall and Ramp)

G/F	$0.6 \times 26 + 0.6 (3.4 \times 5)$	= 25.80 m <sup>2</sup>	
1/F	$0.6 \times 26 + 0.6 (3.4 \times 5)$	= 25.80 m <sup>2</sup>	
1/F Ramp	$0.6 \times 23 + 0.6 (3.4 \times 5 \times 0.5)$	= 18.90 m <sup>2</sup>	70.50 m <sup>2</sup>
		<hr/>	

Panel Areas (with tiles)

G/F and 1/F	$112.00 - (29.04 + 82.96)$	= -
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Panel Areas in Party Wall

G/F and 1/F	$208 - 51.60$	= 156.40 m <sup>2</sup>	156.40 m <sup>2</sup>
		<hr/>	

Building (Energy Efficiency) Regulation  
Form OTTV 1

Calculation of 'U' Value of Composite Wall/Roof  
and Details of Other Values

Sheet No. A 8

BD Ref 2/\_\_\_/\_\_\_/\_\_\_

Building address Typical Commercial Building

Physical data of Opaque \*Wall/Roof

Facade Orientation facing West (Podium)Solar Factor (SF) is 175

*Wall/Roof Code No.	*W <sub>1</sub> /R <sub>1</sub>	*W <sub>1A</sub> /R <sub>1A</sub>	*W <sub>3</sub> /R <sub>3</sub>	*W <sub>5</sub> /R <sub>5</sub>
Location of Wall/Roof	Beams & Cols G/F & 1/F	Beams & Cols G/F & 1/F	Panels G/F & 1/F	Ramp Wall 1/F
External Finish Material	white mosaic tiles	Reinforced	Concrete	Reinforced Concrete
Conductivity W/m°C	1.50	2.16	2.16	2.16
Density kg/m <sup>3</sup>	2500	2400	2400	2400
Thickness m	0.005	0.60	0.10	0.30
Absorptivity (α)	0.58	0.65	0.65	0.65
Intermediate component	cement render			
Conductivity W/m°C	0.72			
Density kg/m <sup>3</sup>	1860			
Thickness m	0.01			
Intermediate component	Reinforced concrete			
Conductivity W/m°C	2.16			
Density kg/m <sup>3</sup>	2400			
Thickness m	0.60			
Intermediate component				
Conductivity W/m°C				
Density kg/m <sup>3</sup>				
Thickness m				
Intermediate component				
Conductivity W/m°C				
Density kg/m <sup>3</sup>				
Thickness m				
Internal Finish Material	white semi gloss paint on gypsum plaster			
Conductivity W/m°C	0.38	0.38	0.38	0.38
Density kg/m <sup>3</sup>	1120	1120	1120	1120
Thickness m	0.01	0.01	0.01	0.01
Absorptivity α	0.30	0.30	0.30	0.30
'U' value of composite *Wall/Roof	1.51	1.55	2.41	1.97
Area of *Wall/Roof m <sup>2</sup>	29.04	70.50	156.40	27.1
Density of composite *Wall/Roof kg/m <sup>2</sup>	1482	1451	250	731
Equivalent temperature difference (TD <sub>EQ</sub> )	2.10	2.10	4.35	2.10

\*Delete as appropriate

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**Building (Energy Efficiency) Regulation**  
**Form OTTV 2**

**Window/Rooflight Schedule**

Sheet No. B 8

BD Ref 2/     /     /    

Building address Typical Commercial Building

Physical data on \*window/rooflight

Facade Orientation facing West (Podium) Solar Factor (SF) is 175

Window/Rooflight Code No.	*F <sub>1</sub> /RL <sub>1</sub>	*F <sub>2</sub> /RL <sub>2</sub>	*F <sub>3</sub> /RL <sub>3</sub>	*F <sub>4</sub> /RL <sub>4</sub>
Location of *Window/ Rooflight	G/F&l/F unshaded			
Glazing type	plain			
Thickness m	0.012			
Shading Coefficient (SC)	0.90			
Type of shading device	-			
External Shading Multiplier (ESM)	-			
Area of glazing m <sup>2</sup>	82.96			

Physical data on \*window/rooflight

Facade Orientation facing                      Solar Factor is             

Window/Rooflight Code No.	*F <sub>1</sub> /RL <sub>1</sub>	*F <sub>2</sub> /RL <sub>2</sub>	*F <sub>3</sub> /RL <sub>3</sub>	*F <sub>4</sub> /RL <sub>4</sub>
Location of *Window/ Rooflight				
Glazing type				
Thickness m				
Shading Coefficient (SC)				
Type of shading device				
External Shading Multiplier (ESM)				
Area of glazing m <sup>2</sup>				

\* Delete as appropriate

**Building (Energy Efficiency) Regulation**  
**Form OTTV 3**

**Calculation of OTTV of Individual Facade in Building Envelope**

Sheet No. C 8

BD Ref 2/\_\_\_/\_\_\_/\_\_\_

Building address Typical Commercial Building

Facade Orientation facing West (Podium).

Opaque \*Walls/Roofs

Code No.	Description	*A <sub>w</sub> /A <sub>r</sub>	U	α	TD <sub>EQ</sub>	Sum
W1	Beams & Cols. G/F&l/F	29.04	1.51	0.58	2.10	53.41
W1A	Beams & Cols. G/F&l/F	70.50	1.55	0.65	2.10	149.16
W3	Panels G/F&l/F	156.40	2.41	0.65	4.35	1,065.75
W5	Ramp Wall l/F	27.10	1.97	0.65	2.10	72.87
Subtotals		283.04	(A)	Heat Gain		1,341.19 (C)

Fenestration

Code No.	Description	*Af <sub>w</sub> /Af <sub>r</sub>	SC	ESM	SF	Sum
F1	G/F & l/F	82.96	0.90	-	175	13,066.20
Subtotals		82.96	(B)	Heat Gain		13,066.20 (D)

Gross Heat Gain (C + D) 14,407.39

Gross Area (A + B) 366.00

$$\text{OTTV} = \frac{C + D}{A + B} = \underline{39.36} \text{ W/m}^2$$

\* Delete as appropriate

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South Elevation (Podium)

Gross Wall Area

264.49 m<sup>2</sup>Wall Composite AreasBeam and Column Areas

G/F	-	=	-	
1/F	$0.6 \times 34.6 + 0.6 (3.4 \times 8)$	=	37.08 m <sup>2</sup>	37.08 m <sup>2</sup>
1/F Stair Wall	$0.1 \times 3.4$	=	0.34 m <sup>2</sup>	0.34 m <sup>2</sup>

Glazing Areas

G/F	-	=	-	
1/F	100.98	=	100.98 m <sup>2</sup>	100.98 m <sup>2</sup>

Ramp

1/F	$5.4 \times 23.35$	=	126.09 m <sup>2</sup>	126.09 m <sup>2</sup>
External wall at ramp omitted	$5.4 \times 40$	=	21.60 m <sup>2</sup>	

Panel Areas

G/F	-	=	-	
1/F	$160.00 - (37.08 + 0.34 + 100.98 + 21.60)$	=	-	-



Building (Energy Efficiency) Regulation  
Form OTTV 1

Calculation of 'U' Value of Composite Wall/Roof  
and Details of Other Values

Sheet No. A 9BD Ref 2/     /     /    Building address Typical Commercial Building

Physical data of Opaque \*Wall/Roof

Facade Orientation facing South (Podium)Solar Factor (SF) is 191

*Wall/Roof Code No.	*W <sub>1</sub> /R <sub>1</sub>	*W <sub>5</sub> /R <sub>5</sub>	*W <sub>7</sub> /R <sub>7</sub>	*W /R
Location of Wall/Roof	Beams & Cols 1/F	Ramp 1/F	Stair Wall 1/F	
External Finish Material	white mosaic tiles	r. concrete	white mosaic tiles	
Conductivity W/m°C	1.50	2.16	1.50	
Density kg/m <sup>3</sup>	2500	2400	2500	
Thickness m	0.005	0.30	0.005	
Absorptivity (α)	0.58	0.65	0.58	
Intermediate component	cement render		cement render	
Conductivity W/m°C	0.72		0.72	
Density kg/m <sup>3</sup>	1860		1860	
Thickness m	0.01		0.01	
Intermediate component	Reinforced Concrete		Reinforced Concrete	
Conductivity W/m°C	2.16		2.16	
Density kg/m <sup>3</sup>	2400		2400	
Thickness m	0.60		3.00	
Intermediate component				
Conductivity W/m°C				
Density kg/m <sup>3</sup>				
Thickness m				
Intermediate component				
Conductivity W/m°C				
Density kg/m <sup>3</sup>				
Thickness m	white semi gloss paint			
Internal Finish Material	on gypsum plaster			
Conductivity W/m°C	0.38	0.38		
Density kg/m <sup>3</sup>	1120	1120		
Thickness m	0.01	0.01		
Absorptivity α	0.30	0.30		
'U' value of composite *Wall/Roof	1.51	1.97	0.69	
Area of *Wall/Roof m <sup>2</sup>	37.08	126.09	0.34	
Density of composite *Wall/Roof kg/m <sup>2</sup>	1482	731	7231	
Equivalent temperature difference (TD <sub>EQ</sub> )	1.40	4.10	1.40	

\*Delete as appropriate

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Building (Energy Efficiency) Regulation  
Form OTTV 2

Window/Rooflight Schedule

Sheet No. B 9

BD Ref 2/\_\_\_/\_\_\_/\_\_\_

Building address Typical Commercial Building

Physical data on \*window/rooflight

Facade Orientation facing South (Podium)

Solar Factor (SF) is 191

Window/Rooflight Code No.	*F <sub>1</sub> /RL <sub>1</sub>	*F <sub>2</sub> /RL <sub>2</sub>	*F <sub>3</sub> /RL <sub>3</sub>	*F <sub>4</sub> /RL <sub>4</sub>
Location of *Window/ Rooflight	1/F unshaded			
Glazing type	plain			
Thickness m	0.012			
Shading Coefficient (SC)	0.90			
Type of shading device	-			
External Shading Multiplier (ESM)	-			
Area of glazing m <sup>2</sup>	100.98			

Physical data on \*window/rooflight

Facade Orientation facing \_\_\_\_\_

Solar Factor is \_\_\_\_\_

Window/Rooflight Code No.	*F <sub>1</sub> /RL <sub>1</sub>	*F <sub>2</sub> /RL <sub>2</sub>	*F <sub>3</sub> /RL <sub>3</sub>	*F <sub>4</sub> /RL <sub>4</sub>
Location of *Window/ Rooflight				
Glazing type				
Thickness m				
Shading Coefficient (SC)				
Type of shading device				
External Shading Multiplier (ESM)				
Area of glazing m <sup>2</sup>				

\* Delete as appropriate

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**Building (Energy Efficiency) Regulation**  
**Form OTTV 3**

**Calculation of OTTV of Individual Facade in Building Envelope**

Sheet No. C 9

BD Ref 2/\_\_\_/\_\_\_/\_\_\_

Building address Typical Commercial Building

Facade Orientation facing South (Podium).

Opaque \*Walls/Roofs

Code No.	Description	*A <sub>w</sub> /A <sub>r</sub>	U	α	TD <sub>EQ</sub>	Sum
W1	Beams and Cols G/F&1/F	37.08	1.51	0.58	1.40	45.46
W2	Stair Wall 1/F	0.34	0.69	0.58	1.40	0.19
W3	Ramp 1/F	126.09	1.97	0.65	4.10*	611.98
Subtotals		163.51	(A)	Heat Gain		657.63 (C)

\* Value interpolated from vert. and horizontal components.

Fenestration

Code No.	Description	*Af <sub>w</sub> /Af <sub>r</sub>	SC	ESM	SF	Sum
F1	1/F	100.98	0.90	-	191	17,358.46
Subtotals		100.98	(B)	Heat Gain		17,358.46 (D)

Gross Heat Gain (C + D) 18,016.09

Gross Area (A + B) 264.49

$$\text{OTTV} = \frac{C + D}{A + B} = \underline{68.12} \text{ W/m}^2$$

\* Delete as appropriate

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**Building (Energy Efficiency) Regulation**  
**Form OTTV 4**

**Summary of OTTV of Building Envelope**

Sheet No. D 1

BD Ref. 2/\_\_\_/\_\_\_/\_\_\_

Building address Typical Commercial Building

Total Envelope Heat Gain (\*Tower/Podium)

Facade Orientation	Gross Area from Form OTTV3	Gross Heat Gain from Form OTTV3
a. East	344.00	31,629.06
b. North	320.00	22,492.56
c. West	366.00	14,407.39
d. South	264.49	18,016.09
e.		
f.		
Subtotal	1,294.49 (E)	86,545.10 (G)
Roof	Carpark under - non accountable	
a. Main		
b. 15/F		
Subtotal	(F)	(H)

$$\text{*Tower/Podium Walls OTTV} = \frac{G}{E} = \underline{66.86} \text{ W/m}^2$$

$$\text{*Tower/Podium Roofs OTTV} = \frac{H}{F} = \underline{\hspace{2cm}} \text{ W/m}^2$$

$$\text{*Tower/Podium OTTV} = \frac{G + H}{E + F} = \underline{\hspace{2cm}} \text{ W/m}^2$$

\* Delete as appropriate